PC
MAGAZINE

Lotus 3 vs. 2.2: Power or Speed— You Can't Have Both

All the Speed You Need? PC Labs Tests 13 25-MHz 386 Machines

Mightier Than the Mouse: 24 Digitizing Tablets for CADD and DTP

Send Binary Files Through E-mail With DEBUGSCR
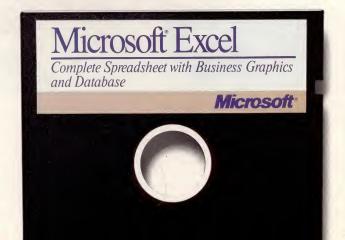
Pick Your Word Processor

Word, WordPerfect, And DisplayWrite Dominate the Market

- **Which Is Best?**
- **They Run Under OS/2— Does It Matter?**
- **How Good Are They At Desktop Publishing?**
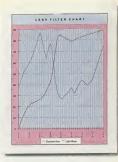- **Is There a Printer They Can't Handle?**

PC
LABS

WordPerfect
Microsoft

For a change, 1-2-3 users can pump out the kind of output that's admired, envied and saved. Not tossed.

Inside

In case you haven't noticed, we live in an electromagnetic world. In fact, if you could see all of the waves, rays, and fields that everyday appliances emit, you wouldn't see anything else.

Though few conclusions have been reached by biologists and physicists, alarms about the potential dangers of electromagnetic radiation are starting to ring more loudly. "Scientists Debate Health Hazards of Electromagnetic Fields" warned a recent *New York Times* headline. The gist of the advice given in the article by some worried experts: don't get too close to your coffee machine, think twice before you use your vacuum cleaner, throw away your electric blanket, and don't even ask about the power lines behind your house—you don't want to know.

PCs also generate large electric and magnetic fields—up to 3 meters across—whose effects are being debated. You may recall that when laptops first came onto the scene, airlines were reluctant to allow passengers to operate them aboard a plane, fearing that their radiation could interfere with navigation.

How did we know that the airlines were wrong? It's the Federal Communications Commission (FCC) that regulates the amount of radiation emission acceptable from a PC. After all, if your PC isn't adequately insulated, your neighbor's TV reception could suffer.

The FCC classifies PC boxes either as Class A, suitable for office use only,

Assistant editor Matthew J. Ross and staff writer Catherine D. Miller rate the office coffee machine Class A; this issue's computers rate Class B.

or as Class B, suitable for use anywhere. Unfortunately for computer manufacturers, the application and testing process for Class B certification can take up to 18 frustrating months.

Generally speaking, the achievement of Class B status indicates better overall engineering, and if you can buy a Class B machine, you should. All of IBM's and Compaq's machines, for example, are Class B. The 13 evaluations of 25-MHz 386 machines in this issue, supervised by assistant editor Matthew J. Ross and introduced by staff writer Catherine D. Miller, all feature models that have Class B certification.

Electromagnetic forces also figure into another section of this issue. Contributing editors Frank Bican and Winn L. Rosch evaluated 24 digitizing tablets, the vast majority of which use electromagnetic sensing as their modus operandi. In his introduction, Rosch explains the differences among *electromagnetic technology*, *resistive decoding*, and balding *sonic triangulation*.

By the way, Rosch reports that when he's evaluating machines in his crowded home office, three or four are sometimes running simultaneously with their covers removed. In the Lab Notes section of a future issue, Rosch analyzes the potential hazards of electromagnetic radiation generated by PCs and peripherals and fills you in on ways to protect yourself.—*Donald T. Willmott*

PHOTOGRAPHY: THOM O'CONNOR

BPA

PC November 28, 1989

Volume 8 Number 20

Several steps faster than the competition.

A s you can plainly see, every Everex STEP™ system, from one end of our IBM® compatible line to the other, runs a good deal faster than anything the competition has to offer. So if you're looking for the absolute fastest way to run today's complex applications, it's time to take a closer look at our STEPs.
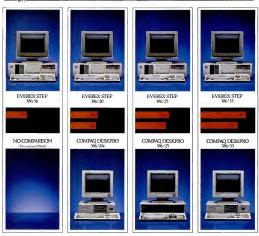
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Letters

The graphical interface: is a picture worth a thousand DOS prompts?

Letters

In the real world of mom-and-pop businesses, we can't get all excited over the hottest and slickest new chips. What we want is a reliable machine at a good price, with decent service and easy-to-use software. What you want us to do is give up our $1,299 price on a good 286 machine in favor of a $1,799 price on a computer that has *nothing* better to offer!

I know there are Fortune 500 companies out there that always buy the latest and greatest, no matter what the cost. But down here in the much larger small-business arena, we have to justify our automation costs or we don't eat.

David L. Morris
Dallas, Texas

HITTING THE STORES

After reading William Zachmann's bashing of computer retailers (William F. Zachmann, *PC Magazine*, September 12, 1989), I thought it was time to tell the dealer's side of the story.

I receive at least five calls a day from people asking for technical help with mail-order accessories or computers they've just purchased. I have at least three or four people a week stop in my store to get a good look and "hands-on feel" for a product they plan on buying mail-order.

Most manufacturers require dealers to have on-site service facilities and expensive training for technical and sales representatives. Eighty percent of my customers are business owners who have had little if any PC experience. My job is not only to sell them a system but, unlike mail-order outfits, to make that system productive. Or else personally face the music.

I can justify my higher prices: it's called overhead. Rent, payroll, merchandise flooring, taxes, interest, and advertising. I'm not getting rich, as Zachmann would like people to believe.

Computer stores still sell the vast majority of computers in this country and without them, the industry would wither away. Yes, there are plenty of "bad" computer stores out there, but there are also a lot of good ones—stores that will flourish because of good service.

David J. Raczka
Lockport, New York

A large "Congratulations!" for the editorials of Machrone, Seymour, Zachmann

(again), and Manes in the September 12 issue. I am a recent computer buyer. I am also pursuing litigation against my "friendly" computer store for misrepresentation. It seems there is a motherboard in my system with "16 MHz" written all over it, being driven at 20 MHz. This is after the salesman and I discussed the sidebar entitled "Crystals, Components, and the Dangers of Speed" that appeared in your magazine ("The Controversy Continues: 286 vs. 386," *PC Magazine*, June 27, 1989) and he assured me that his store did not sell overoscillated computers. Right.

I hope computer store managers, owners, or whoever gives a damn about satisfaction (there *is* somebody, isn't there?) read

> Small-business owners can't get all excited over the hottest and slickest new chips. We want a reliable machine at a good price.

your editorials and take heed. I also caution any would-be buyers not to take anything for granted. Check *everything* out. It should be worth a few hours of the salesperson's time for you to spend a few thousand dollars of *your* money at his or her establishment.

Two thumbs up for *PC Magazine.*

Michael Ogden
Nashville, Tennessee

NOT QUITE DEAD-END USER

John Dvorak's latest diatribe (John C. Dvorak, *PC Magazine*, September 12, 1989) reminds me of the bully on the block looking to punch someone—anyone—in the nose.

This time John has "discovered" that a lot of users are using only 1.7 software packages. And if that wasn't bad enough, his mother-in-law has had to take any number of courses to learn WordPerfect. What is the lesson to be drawn from these two disparate facts? That the software companies have foisted complex pack-

Some views on why the NEC MultiSync

There's a lot more to the new MultiSync® 3D monitor from NEC
than meets the eye. Because instead of making one monitor for each
graphics board, we've devel-
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Front

Back

the performance of the modes on
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Side

Top

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F is for Flags

G is for Gears

H is for Heart

I is for Ice Cream

J is for Jet

K is for King

L is for Lobster

M is for Motorcycle

N is for Nutcracker

O is for Olympics

P is for Penguin

Q is for Quack

R is for Reagan

S is for Santa

T is for Texas

U is for Uncle Sam

V is for Valentine

W is for World

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Z is for Zip Code

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Letters

ages without standard interfaces on the helpless user community and said community has rebelled by refusing to buy dozens of new packages?

Come on, guy, get real. You've been in the PC business so long now you seem to have forgotten what the two most popular types of software packages (spreadsheets and word processing) supplanted: pencil-and-paper and the typewriter. If I were to use only *WordPerfect*, that would still be a vast improvement over the Selectric typewriter now gathering dust on my closet shelf.

Aside from *WordPerfect*, *Quicken* is the only other package I use with any frequency. A little over 1.7, I guess, but Dvorak would no doubt still classify me a Dead-End User. Well, I've got news for you, buddy; this is all I *want* from my PC. Sound shocking? Here's more: I wouldn't mind if *WordPerfect* were menu-oriented, but I was able to write, edit, and print a letter the first day I got the package using a relatively limited number of commands. I accomplished this amazing feat the old-fashioned way: I read just a few pages of the documentation.

Simply put, John, the number of packages used does not equate to package usefulness or customer satisfaction.

John T. McMahon
New York, New York

■ **A MORE ATTRACTIVE PORT**
The review of 14 data switches in your July 1989 issue ("Data Switches: A Low-Cost LAN Alternative") contains an error-filled review of our Systemizer Plus Connectivity Network. The most glaring and damaging error in your review: our price per port was repeated several times in the article as $399—which, on the average, is twice the cost of all the other products reviewed.

However, as your price per port was arrived at by dividing the retail price of each box by the number of serial or parallel ports it contains, a more careful analysis of our product would have revealed the existence of *two* DB-25 connection ports on the back of the Systemizer Plus. Since our suggested retail price is $399, dividing that by 2 yields a price per port of *$200*, which is on par with the majority of the boxes tested, and lower than the winners of your Editor's Choice award.

> If I were to use only *WordPerfect*, that would still be a vast improvement over the Selectric typewriter now gathering dust on my closet shelf.

Then factor in that ours are bidirectional I/O ports, that each can be set independently for serial or parallel operation, and that a separate third port is included for networking the Systemizers together, and further value is added per port.

Tim Wilde
President
Applied Creative Technology Inc.
Dallas, Texas

PC Magazine regrets the price-per-port error contained in the review of the Systemizer Plus Connectivity Network. We stand firm that the product, though meritorious, would not have been our Editor's Choice.

■ **WANTED: A FEW GOOD UTILITIES**
I would like to echo the sentiment expressed by A. Leyder (Letters, *PC Magazine*, September 12, 1989). I (and likely many other corporate readers) am faced with similar choices. I don't have time to type in these great utilities you offer, nor is my company willing to allow me a PC MagNet account. I know that $10 to $15 for an occasional utilities disk update would be no problem. Meanwhile, mark me as another "faithful but frustrated" reader.

James Eddy
Hartford, Connecticut

HOW TO WRITE TO PC MAGAZINE

Send letters to *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). All letters become the property of *PC Magazine* and are subject to editing. ■

by Lori Grunin

Advisor

PARKING HEADS

I have often read that it's important to park the heads on your hard drive before you turn your machine off. How can I determine whether my hard drive parks its heads automatically? If it doesn't, where can I find a program or utility that will do it?

Felice Martinello
St. Catharines, Ontario
Canada

- **PARKING HEADS:** Programs to park your hard disk drive's head.

- **FROM APPEND TO XCOPY AND BEYOND:** Starting a computer reference library.

The conclusive way to find out if your hard drive auto-parks is to call the manufacturer and ask. Short of that, you can use rules of thumb: if your drive has a stepper motor head actuator (rather than a voice coil), it probably doesn't auto-park. Small drives and drives that cost significantly less than their same-size competition usually use stepper motors; all drives over 100MB use voice-coil technology. (You can find a complete discussion of actuators, as well as head parking, in *Upgrading and Repairing PCs*, cited in the response to the question following this one.)

Head-parking utilities tend to be drive-specific, so check the software that accompanied your drive to see whether the manufacturer included one. If the software sets you prepare your computer for moving (or words to that effect), that's your head parking. Similarly, some commercial disk utility software comes with head-parking programs as well.

There's an occasional debate over whether or not the heads need to be parked every time you turn off the computer's power or just when moving your system. The consensus seems to be that it can't hurt to park the heads, so you might as well do it before every power-down. Using a utility that's not meant for your drive—for instance, using the parker that came with your sister's ESDI CDC on your SCSI Seagate—might damage your data.

That said, there are quite a few public domain and shareware head-parking utilities floating around on PC MagNet and CompuServe that work on most drives.

All good head-parking utilities give you the opportunity to change your mind and release the heads from their parked position before turning off the machine's power.

The following are all available in data library 1 of the IBMHW forum on CompuServe: SHUTDOWN, a $5 shareware program (filename: SHUTDO.ARC), works with up to eight drives; TIMEPARK, a public domain program (filename: TPARK1.ARC), will park the heads automatically when the drive hasn't been used for a user-specified period of time; HDPARK (filename: HDPARK.ARC), for which the voluntary contributions of $1 or more are donated to charity; and a public-domain parker designed specifically to operate with IBM PS/2 drives, PS2PARK (filename: PS2PRK.ARC).

You can also find a *PC Magazine* utility, PCPARK (filename: PCPARK.ARC), in data library 7 of the Utilities forum on PC MagNet (for downloading information, see the ''By Modem'' sidebar in the Utilities column of *PC Magazine*). For more information about the desirability of head parking or for the debug code to generate PCPARK, check out the PC Tutor column in the March 15, 1988, issue of *PC Magazine*.

FROM APPEND TO XCOPY AND BEYOND

I'm thinking of upgrading my IBM PC AT from PC-DOS 3.2 to DOS 3.3. Do I have to use PC-DOS 3.3, or may I use MS-DOS 3.3 (which I might get at a better discount) without causing any operating system problems?

Also, judging from the many volumes I see in bookstores, there must be a better DOS book available than my IBM DOS manual. I would like one that gives a detailed description of all commands, as well as an explanation of the differences between MS-DOS and PC-DOS.

Gerhard Opel
Pukalani, Hawaii

Well, you *can* use MS-DOS 3.3 on your AT. Operating systems depend on BIOS compatibility, and ''PC compatible'' means (among other things) compatibility with IBM's BIOS. But you *can't* get MS-DOS at a better discount than PC-DOS; at least, not legally. Microsoft licenses MS-DOS to systems manufacturers, who either add little improvements, incorporate fixes to ensure 100 percent BIOS compatibility, or just sell it as is. The companies can sell MS-DOS only in conjunction with their systems. On the other hand, you can wander into any computer store and buy a copy of PC-DOS.

As for your other question, although at first glance there seems to be an overabundance of books on DOS cluttering up the shelves of your neighborhood bookstore, these can really be broken down into a few different categories: introductions, tips for power users, general reference books, and programmer's references. Of course, some of the books overlap in several of these areas, but they're still geared to specific audiences.

One of the most popular DOS books is Van Wolverton's *Running MS-DOS*, Fourth Edition ($22.95; ISBN 1-55615-186-1; Microsoft Press, 16011 NE 36th Way, Box 97017, Redmond, WA 98073; (206) 882-8080). It's a good book, but if you've been using DOS for a while, you might prefer something that is slightly more advanced; although Van Wolverton's book has the requisite detailed listing of commands, he spends quite a lot of time showing users the DOS ropes.

If you're a beginner, another book that

Advisor

might meet your needs is Chris DeVoney's *MS-DOS User's Guide*, Third Edition ($22.95; ISBN 0-88022-349-9; Que Corp., 11711 N. College Ave., Carmel, IN 46032; (317) 573-2500). DeVoney's book comes shrink-wrapped with a quick-reference guide. Both books provide excellent introductions to DOS.

On a more advanced level there's *The Waite Group's MS-DOS Bible*, Third Edition, by Steven Simrin ($24.95; ISBN 0-672-22693-6; Howard W. Sams & Co., 4300 W. 62nd St., Indianapolis, IN 46268; (317) 298-5400), which is a true reference book—it's arranged so that you can easily find answers to questions instead of using the tutorial format others use.

The *MS-DOS Bible*'s step-by-step instructions are for would-be DOS programmers rather than DOS novices, and an appendix provides information on some undocumented MS-DOS interrupts and functions. In addition to providing a description and the syntax of each command, the book offers more in-depth in-

formation on such items as interrupts and functions, which can help you better understand any problems you may encounter with poorly behaved software.

At highest end of the complexity spectrum is the $65.95 *MS-DOS Encyclopedia*, put out by none other than Microsoft Press (ISBN 1-55615-174-8; see address above). This book not only gives detailed descriptions of the commands, but also lists and explains all the possible error messages you get with each command. Geared to programmers, however, it might be too advanced for your purposes.

If you're planning to customize your DOS environment, or if your PC refuses to wake up one morning, there are a few other reference books you might want to consider.

Under the category of power user guides, another one of Chris DeVoney's guides, *MS-DOS Tips, Tricks, and Traps* ($22.95; ISBN 0-88022-376-6; Que Corp.; see address above), provides a plethora of helpful hints, organized in an easy-to-follow manner, without wasting space on meaningless graphics. Similarly, *PC Magazine*'s own *DOS Power Tools, Techniques, Tricks and Utilities* edited by Paul Somerson,

offers hints and on-disk and in-print utilities ($44.95; ISBN 0-553-34526-5; Bantam Books, 666 Fifth Ave., New York, NY 10103; (212) 765-6500).

And since DOS won't run if you don't treat your hardware right, consider investing in Scott Mueller's *Upgrading and Repairing PCs* ($27.95; ISBN 0-88022-395-2; Que Corp.; see address above). In addition to being an excellent guide for troubleshooting hardware problems and offering advice to upgraders, Mueller provides aid to new-system buyers when they're making purchasing decisions.

I'm not trying to provide a definitive list of books you *must* have, and I've probably overlooked some people's favorites. But if you put a few of these books on your shelves, you should be able to handle almost any question or problem you encounter in the future.

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). Please specify your equipment. ∎

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First Looks

Hands-on Reviews of the Latest Products

Autodesk Animator Brings Affordable Full-Screen Animation to the PC

HANDS ON
by Luisa Simone

The future of PC-based desktop presentations has arrived. Though far from perfect, *Autodesk Animator* takes the standard PC "slide show," which usually consists of scripted transitions between static images, and makes it come alive with movement. The $299 program allows users to create the video presentations of tomorrow on the VGA systems of today, and in the process it may well become the paradigm for other bitmapped graphics programs.

Traditional animation requires that you crunch out individual frames, each slightly different, and then link them together to create the illusion of movement. Although *Animator* gives you this option from within its Traces menu, the real power of its menu-based, interactive approach is that it lets you forget about the repetitive nature of animation and creatively paint with time.

Not even Einstein found it easy to explain that time is just the fourth dimension of our world, and though *Animator* labors to prove that any normal painting function can also be a time function, the concept is hard to grasp.

Time and movement are obviously related, and so the Optics menu in *Animator* is seemingly easy to understand. You can create abstract movement paths that guide the motion of entire animations or of individual objects (cels), Preset func-

tions let you spin, rotate, and resize your images, but it is the advanced options, such as pathing, that release the open-ended potential of this product.

Using irregularly shaped spline or polygon tracks together with a clocked function (which records and then uses the changing velocity of your mouse movements to create a path that varies in speed as well as direction), the program allows you to move objects in an incredibly natural way; think of a fish swimming—slow, then fast, then slow again.

The same time concept can be applied to almost any function within the program. For example, if you invoke the tinting function of the Palette menu with the Time icon turned on, you can fade a picture to white. You can choose to apply the tint to one frame, a range of frames, or all the frames in your animation to simulate different durations. You can even opt to use a special effect with the tinting function; a ping-pong fade, for example, will fade the image to white and then reverse the whole operation, creating images that last for specific intervals.

Actually performing a ping-pong fade to white in a 64-frame animation sequence requires 4 menu operations and takes about 3 minutes, which clearly illustrates that it is harder to understand *Animator* than to use it. In part, the fault lies with the program's overly complicated and inconsistent use of terminology and menus.

For example, *Animator* refers to something as common as a gradient color range as a *cluster* that has been *ramped*. And what most people understand as

shape interpolation (the gradual transformation of one object into another) *Animator* calls *tweening*, which, forgive me, sounds like something from Roger Rabbit's Toon Town.

Some of these terms were originally coined by developers for the Amiga, long known as a rich environment for animation development. But some attempt to translate the Amiga's lingua franca to a language common to PC-based programs would be welcome.

In addition, *Animator's* menus are anything but SAA-compliant. The F1 key, for example, doesn't bring up the help menu. In fact, other than a brief description that pops up when you change tools or inks, there is no on-line help in *Animator*, a real handicap for beginners.

More serious are inconsistencies in the program's icon conventions and menu-versus-toolbox organization. For example, the Time icon is always in the right-hand corner of the dialog boxes—except when it isn't. And the Separator tool

Animator's drop-down menus augment its paintbox, by offering more-sophisticated animation functions.

Animator

works slightly differently if you access it from the toolbox as opposed to the PIC menu. When invoked from the PIC menu, the Separator tool tries to replace the color you click on with the currently selected color throughout the frames in your animation (or, in other words, over time). The toolbox version, however, makes the change to only one frame. This would be forgivable if the other choices in the PIC menu also were associated with time functions, but they are not. So why not just have the Separator function work across frames when the Time icon is activated?

The main menus—Animator, Flic, Pic, Cel, Trace, Swap, and Extra—didn't always contain the functions I expected. Optics, which I would have associated with Traces (because they are two different ways to create movement), is only accessible from the Animator menu. Expect to spend one solid week diligently learning both *Animator's* sophisticated concepts and its sometimes-confusing menus.

There are instances in which the menus are clear and concise. Composite and Join, which let you manipulate individual flics (or animated sequences) to create more-complex images and longer-running animations, respectively, are quite logically located on the Flic menu. And it takes almost no time to learn how to use the various memory buffers to your advantage. The cel buffer, which keeps an object in memory, is on the Cel menu, and the alternate work page, which can be used as a clipboard, is on the Swap menu.

The paint portion of the program deserves praise for making heavy-duty tools readily accessible. The 12 individual painting tools can be used in conjunction with 26 different inks (or surfaces) and 256 simultaneously displayed colors (from a palette of 262,000 hardware colors).

Although only six tools, six

inks, and a minipalette are displayed at any one time in the toolbox, right clicking on any of these objects brings up an appropriate dialog box from which you can pick substitutes.

But, again, the program begins to increase the complexity—and the number of options—at this point. Many of these tools have individual submenu options, like Dapper and Tweening. And the palette manipulations are so elaborate that another complete menuing system is necessary to create color clusters for gradient fills, to sort colors by hue or brightness, or to compress a palette imported with a scanned image. This last function is especially useful if you want to combine two radically different palettes in order to use two scanned images in the same flic.

In the course of learning to use *Animator*, I managed to crash the program by losing my way in an endless loop of palette alterations. The underlying problem here is that *Animator*

picks up its configuration information from the temporary working files that it stores in a subdirectory called \AAT, even if those files have been trashed. So once the program crashes—and even though the manual contains no explicit directions on this point—it is important to delete these bad files from the temporary directory. If you don't, *Animator* automatically loads with screen garbage and locks up.

Animator runs in only one video mode, VGA 320 by 200 with 256 simultaneous colors; this is wonderful if you work exclusively with scanned images, but it is inadequate if you want to paint an image from scratch. To its credit, *Animator* comes with a knockout conversion utility that translated high-resolution 640-by-480 .PCX files, like the fish in our screenshots, with no problems. Amiga animation files and Targa full-color or continuous-tone images can also be converted to the appropriate .GIF format. The .GIF

format is useful because of its stability and because so many public-domain images can be downloaded from Compu-Serve.

Animator does support LIM 4.0 expanded memory, but it is designed to utilize only 64K of EMS in order to run on the widest possible hardware platform—including, if you can believe it, 8-MHz 8086s. As a result, large and temporary files are swapped out to a fixed disk or a RAMdisk. In the long run, it is more efficient to use the utility program, *AAPlay*, to link smaller animation sequences together at playback time. Not only does this keep disk swapping to a minimum, but it gives users a nifty mechanism for bypassing the 4,000-frame limitation *Animator* imposes on any one sequence. In addition, *AAPlay* allows you to create run-time versions of your show.

By adding time elements to an exceptional two-dimensional graphics package, *Animator* increases the power of paint programs exponentially. Unfortunately, the level of complexity keeps right in step. *Animator* is fun to use and watch, but it ain't easy.

With the increased availability of VGA-to-NTSC conversion boards, you can even record your animations directly from your PC to your VCR. The possibilities are exciting. With some MIDI equipment, you might challenge MTV from the relatively modest location of your desktop. PCTV—the future is here. ∎

The simplest animation technique—motion across the x-y axis—is made more natural by *Animator's* spline function. Each of the four fish can travel on a unique track.

DeScribe, First PM Word Processor, Better at Undoing Than Doing

HANDS ON
by Edward Mendelson

The most spectacular feature of *DeScribe* isn't any of the things it can do. It's everything it can *undo*. DeScribe Inc.'s $595 WYSIWYG word processor and desktop publishing package for the Presentation Manager lets you change your mind about everything you've written and formatted during your current session.

If you want to recover a sentence that you deleted 2 hours ago, for example, simply choose Undo from the Edit menu and move a scroll bar to play back your session in reverse. You can revert to any prior state of format and text, or, when some long-abandoned text appears on-screen, you can cut it to the PM clipboard and insert it into the current state of the file. Nothing in the DOS world comes close.

DeScribe knows other tricks—not all of them based on OS/2—that most of its DOS counterparts will envy. It lets you run two search-and-replace strings simultaneously, and it lets you compile macros for increased speed. The speller and thesaurus include definitions.

Styles can be hierarchical, so that top-level styles will apply to a whole document while lower-level styles add additional details or modifications. Every other word processor makes you use a special code to insert a page number in a header or footer; *DeScribe*, however, lets you "format" a character as a page number, so that it will be incremented automatically on the following pages.

DeScribe lets you create text boxes with multicolumn text inside. It offers interactive word spacing, letter spacing, and kerning, and it gives you *Ventura Publisher*–like control over the number of hyphenated lines that can appear in a row.

Like *Sprint*, *DeScribe* frequently saves a backup "snapshot" of your work to disk, and it automatically offers to use the backup when you open the program after a system crash. Like *WordPerfect*, *DeScribe* lets you assign different dictionaries to different areas of text. But unlike any other word processor, *DeScribe* lets you stretch or compress characters horizontally with printers that use scalable fonts.

Unfortunately, these impressive features are balanced by equally impressive limits. Amazingly, *DeScribe* doesn't have a command to jump to a specific page. It doesn't have an unambiguous page-break command, only an End of Section command that doesn't always end a page.

The program doesn't offer built-in superscripts or subscripts; instead, you have to write a macro that changes the leading and point size of the characters. You can't use superscripts for footnotes, because *DeScribe* doesn't create footnotes—or indexes, lists, or tables of contents.

You can import any text you want—as long as it's pure ASCII. No filters or conversion programs are provided. You can import graphics only via the Presentation Manager clipboard, and the only format supported is PM Metafile. Until the next version shows up, you'll have to buy another OS/2 application that can import or create Metafiles and use it to put the graphic in the clipboard.

Don't use *DeScribe* with anything slower than a 33-MHz machine. It's reasonably fast for

> *DeScribe's Undo feature lets you replay an entire session. You can copy text from an earlier stage into the current version or revert to an earlier version.*

a WYSIWYG program, but with a 16-MHz machine, you'll spend most of your time waiting for the screen to catch up with the keyboard. An upgrade for 386 machines costs $29.95—a needless annoyance, since a 286 is too slow for the program anyway.

Even on a 386, *DeScribe* could make better use than it does of OS/2's multithreading. Paginating and justifying a long document is a painfully slow process, and you can't do anything else while it occurs. To make matters worse, if you happen to click OK on some of the formatting menus—even if you've made no changes at all—*DeScribe* repaginates and justifies the whole file. This is the ideal program for anyone who needs to be forced to take a break from work.

The program's menu structure has its own frustrations. If you select Point Size from the Styles menu, a submenu offers only a limited group of sizes. If the size you want isn't listed, you have to go back to the Styles menu and select Other before you can enter the size.

Don't expect much help from *DeScribe's* manual, which is organized according to the menus rather than by function

and has an inadequate index. Nothing in the manual tells you that only Metafile graphics can be imported. The forbiddingly technical macro language is documented only in a 44-page file that you have to print by yourself. You get free tech support for 90 days, but after that, prepare to fork over $10 for the first 3 minutes and a dollar for each additional minute, or pay $95 for a year of single-user support or $1,100 for a year of corporate support.

If you absolutely need a Presentation Manager word processor, *DeScribe* is your only choice at the moment. If you can wait, hold off until early 1990, when you'll be able to choose between an improved version of *DeScribe* and a PM version of *WordPerfect*.

1-2-3 Macro Programmers Get Full-Featured Development Tool with Baler 5.0

HANDS ON
by Rock Miller

When *PC Magazine* last looked at spreadsheet compilers ("1-2-3 by Any Other Name," December 22, 1987), *Baler* offered a subset of *Lotus 1-2-3*'s capabilities in a software package of interest mainly to programmers. With its $495 Version 5.0, the program has evolved into a full-featured developer's tool for anyone who feels comfortable working with *1-2-3* macros.

Like the old *Baler*, the new version turns a spreadsheet file into a standalone program that can be run independently of the

worksheet can be run as is, but if you want to modify it, you use CUSTOMIZ, *Baler*'s menu-driven customization utility, instead of splashing around in BASIC.

The new *Baler*, in fact, gives you far-reaching control over the appearance and operation of the finished worksheets. By default, the command and macro menus look like *1-2-3*'s, but you can change them into pulldown menus or even vertical-format pop-up menus (for macros). The BalerDraw module lets you dress up your worksheets with lines and boxes made up of the IBM Extended graphics set. New video options

Baler, Version 5.0, lets you build standalone applications using the functions of *1-2-3*.

spreadsheet program (in this case, *1-2-3*) that created it. This lets you distribute worksheets to those without a copy of *1-2-3*, saves some disk space, and, most important, protects your valuable formulas and macros from being stolen by snoops or wiped out by sausage-fingered users.

While the old *Baler* created QuickBASIC code that then had to be compiled, Version 5.0 generates an executable program directly. The compiled

let you access the 43-line EGA and 50-line VGA modes from a menu. *Baler* even lets you build fully indexed, context-sensitive help systems.

Baler is intended to be a macro programmer's tool and thus assumes a fair amount of skill. Fully protecting your worksheets, for instance, requires mastery of *Baler*'s somewhat complicated security scheme. Although "baling" prevents others from seeing your formulas, a user can over-

write the formula cells unless you protect them. This design lets the user do "what-if" analyses by overriding the calculated value with a new one. But it also means that the cells can be unprotected from within the runtime module unless you use CUSTOMIZ to disable these menu entries.

Fortunately, this procedure is well documented, and you can save command-access settings for reuse in other worksheets. Indeed, if your worksheet makes extensive use of macro menus, you may prefer to lock all the *1-2-3* menus from keyboard access. But if you'd rather not deal with *1-2-3*'s protection features, you can use CUSTOMIZ to secure entire classes of cells (such as formula cells). Variable data can be stored in encrypted form to protect it or in .WK1-compatible form for interchange with *1-2-3* users or other applications.

Baler really comes into its own in combination with *1-2-3*'s macro language, which lets you use *1-2-3* to develop complex standalone applications. *Baler* supports most *1-2-3* 2.0 macro commands and functions, including the Graph and Data features. It also offers a number of extensions, that let you assign operations to function keys, restrict movement to within a certain range, and pop up help lines or otherwise customize the screen.

Be warned, however, that you may have to change some of your macro-programming methods. Since formulas are bound into the baled worksheet, you can't use macros that modify formula or macro cells. You also can't insert columns or rows within the bounds of the worksheet, though you can insert rows below the bail line to add database records, for example. The manual has a thorough discussion of these pitfalls and offers suggestions on how to get around them.

The documentation is short on examples, however, especially for advanced features like *Baler*'s "drill-down tables." These let you assign macros to individual cells, which are executed when you press Enter on that cell. The uses of drill-down tables are many, from customizing the movement of the cursor to implementing point-and-shoot operation. But you must write fairly complex macros to get this feature to work properly, and the manual and sample worksheet don't go nearly far enough toward explaining it clearly.

Baler compiles reasonably quickly, and it executes macros noticeably faster than *1-2-3* alone. But its recalc performance lags behind that of *1-2-3* 2.01. *Baler*'s minimal recalculation and math-coprocessor support, however, can boost its performance on calculation-intensive jobs. And its virtual memory system lets you use disk and extended memory as well as expanded memory to stretch the size of your workspace.

Always a good idea, *Baler* has matured into an excellent alternative to other application-development tools, especially where *1-2-3*'s macro language is well known and understood. If you program for others, *Baler*'s versatility makes it well worth the price. ∎

First Looks

PacificPage Puts High-Quality PostScript In a Slow Cartridge

HANDS ON
by Edward Mendelson

If you're surprised to find a product that squeezes Post-Script into a LaserJet cartridge, wait until you start using it. Pacific Data Products' $695 PacificPage cartridge has an even better surprise up its narrow plastic sleeve. Plugged into a 300-dpi-per-inch LaserJet Series II, this cartridge produces pages that look strikingly better than those produced by any 300-dpi Adobe PostScript printer.

The beauty of the cartridge is its PhoenixPage PostScript interpreter, a PostScript clone from Phoenix Technologies. Most PostScript clones suffer from their inability to use Adobe's proprietary "hints," which improve font quality at resolutions below 600 dpi. But PhoenixPage incorporates Bit-

Once you've torn do[...]
laws in the country
yourself face to face
Devil, what will yo[...]

The PacificPage produces high-quality output.

stream's new Quality Enhancement Module, which improves font quality through a set of "rules." Just as Adobe's hints work only with Adobe fonts, Bitstream's rules work only with Bitstream fonts like the ones included with the Phoenix-Page interpreter.

Bitstream's rules tend to produce smoother curves at small sizes than Adobe's hints, and Bitstream's font designs are more subtle and less homogenized than Adobe's. The result is livelier and more readable text (although the type is still not as good as the best bit-mapped LaserJet fonts), with graphics that match Adobe's.

To use the PacificPage cartridge, you'll need a Hewlett-Packard LaserJet Series II (the IID will be supported by a future revision) with 2MB or 4MB of add-on memory. You'll also need a Type B personality, because this cartridge changes the LaserJet from quickstarter to molasses. In PC Labs' bench-

BENCHMARK TESTS: PACIFICPAGE

Although twice as fast at producing text as the software PostScript interpreters we tested in the April 11, 1989, issue ("Post-PostScript PostScript: Add-in Boards for the HP LaserJet"), PacificPage outputs graphics much more slowly than software interpreters, add-in PostScript boards, and the Apple LaserWriter IINT and IINTX.

Relative Performance
(Apple LaserWriter IINTX = 100)

The **Text Speed** test uses a two-page single-spaced business letter: one copy for dot matrix printers, ten copies for laser printers. Print speed is measured in characters per second for dot matrix printers and in pages per minute for laser printers. Because the test document simulates a typical business letter with lots of white space, the speeds achieved by dot matrix printers are

almost always much slower than their manufacturers' rated speeds, which are based on printing a single full line of characters.

The **PostScript Graphics Times** test clocks the processing speed of PostScript printers. It uses two large characters as a clipping area and draws a series of Bézier splines. The time reported is the number of seconds it takes to print a page.

	Throughput Test (Pages per minute)	Performance Time Test (Seconds)
	Text Speed	**PostScript Graphics Times**
Apple LaserWriter IINTX	6.80	436.00
PacificPage	2.10	953.00

mark tests, the cartridge produced text at a mere 2 pages per minute, while the small test graphics files took a stupefying 16 minutes.

One alternative to the PacificPage is QMS's Adobe-licensed JetScript board, which plugs into your computer and connects to the printer via a video cable. The JetScript is the slowest of all PostScript boards, but in tests it printed text two and one-half times faster than the PacificPage—and graphics more than six times faster.

When you plug the PacificPage into a LaserJet, the printer is transformed into a PostScript printer. You can't use it as a LaserJet until you press some buttons on the front panel, issue a software command from DOS, or turn off the printer and remove the cartridge. You have to remove any add-in board that connects to the printer with a video cable. You can use the PacificPage as a printer, but its slowness makes shared or

network use impractical.

You can use up to four non-Adobe soft fonts at a time with the PacificPage, but if you want type quality equal to the 35 built-in fonts, you'll need to create soft fonts using Bitstream's Fontware, Version 3.0, and the advice in the next two paragraphs, which you won't get from PDP.

When generating PostScript fonts with Fontware for Microsoft Windows, choose "Alternative PostScript PDL printer (QEM)" as your output device. The resulting fonts will be compatible with the "rules" in Bitstream's Quality Enhancement Module. If you choose the AppleWriter or other PostScript printer, the fonts will print but will look coarse and won't be affected by the "rules."

Using Fontware for Word-Perfect is more complicated. You use WordPerfect's PTR program to modify WPRINT2.ALL, where you select the Apple LaserWriter definition; then you change the Soft Font Format Type from "Other" to "Alternative PostScript Device (Clone)." Now when you run Fontware, you automatically generate fonts compatible with the QEM. Service bureaus will have equivalent Bitstream fonts, so you can use the cartridge to proof pages destined for a Linotronic typesetter.

Adobe recently announced that it will make public its proprietary hints. When this happens, PDP will offer an optional upgrade to the PacificPage that will let it use Adobe soft fonts. By that time, you may be so pleased with Bitstream's fonts that you won't care. ■

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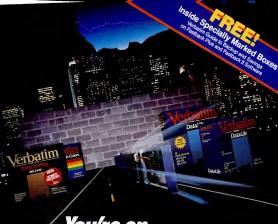
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IBM

First Looks

VGA Producer Turns Static VGA Graphics into Video

HANDS ON
by Alfred Poor

The VGA Producer consists of a full-length 8-bit add-in board and a remote control unit.

Not ready to shell out for high-end video-conversion equipment? For a comparatively modest investment of $1,695, Magni Systems' VGA Producer lets you combine VGA graphics with video, giving you many of the same capabilities as professional video-effects equipment that costs over ten times as much.

VGA Producer consists of a full-length 8-bit add-in board, which connects to VGA cards that have a 28-pin, socketed RAM DAC (not all do); and a remote control unit, which lets you control VGA Producer's effects features. The board encodes a VGA graphic into an NTSC composite video signal, and it can combine this signal with a second composite video signal coming from a VCR or camera. In addition to NTSC signals, the board can also handle Super VHS (S-VHS) video signals.

The remote control console that accompanies the board is what you use to achieve some fairly sophisticated effects; no special software is required. The three-button unit has a sliding control that, in its simplest use, lets the VGA graphic fade to the video image and back again. Pressing the appropriate buttons will let you perform cuts (i.e., switch instantly from one image to another) and automatic fades, in which you can control the time it takes for one image to fade into another. Automatic fades can range in length from a snappy half second to a glacial 10 seconds. You also can adjust the position of the VGA image within the screen, with separate adjustments for horizontal and vertical position. Two LEDs on the controller's panel indicate which programming mode has been selected.

These simple effects are just the start. You can select a color to define as a key and then drop out those keyed portions of the VGA image, letting the second video image show through the "holes" in the first image—the same technique that puts television reporters in front of weather maps.

The VGA Producer also lets you invert the effect, so that the keyed portion of the image remains and the rest of the VGA image drops out. All of this magic is made possible by VGA Producer's genlock capability, which allows it to synchronize the signals from two composite video sources.

INSTALLATION

Installing the board is a fairly straightforward task. VGA Producer requires that your VGA card have a socketed DAC (digital-to-analog converter), because you must be able to remove that chip and place it on a small circuit board; you then install the circuit board on your VGA card. (If you're not exactly sure whether your card has a socketed DAC, be sure to contact Magni Systems, which can

supply you with a list of cards that can be used with its board.)

Moving the chip may seem daunting, but it's really very easy; anyone who can install a memory chip or a math coprocessor will have no difficulty with this step. You may have to exert a fair amount of pressure on the circuit board to properly seat the chip in the chip socket; be brave and push hard. A ribbon cable passes the video signal between the VGA Producer and your VGA board. Once you've plugged in the remote effects controller and your composite monitor, you're ready to roll. Your regular VGA monitor will perform exactly as it did before the installation.

If you do have a problem installing the VGA Producer, it may be because of its height and thickness. The board sticks up about three-quarters of an inch above the top of the end bracket, and it has a little card that juts out of its surface, making the whole unit more than five-eighths of an inch thick. Its width may make for a snug fit if you have thick cards in adjacent slots, and you'll probably want to make sure that your system unit is tall enough to house the board.

VGA Producer's documentation is excellent, but the system is so easy to use that you may well find yourself using all but the most sophisticated features just by following your instincts. In no time at all, you will be performing cuts, fades, and keys, combining your VGA images with other video pictures. ■

PHOTOGRAPHY: THOM O'CONNOR

CarrierNET Builds LANs Without Cables

by Kimberly Maxwell

With Carrier Current Technologies' CarrierNET set of peripheral-sharing utilities and AC power adapter ($199) and Excelltech's *ExcellNET* file-sharing and e-mail software free-marketed by Carrier Current at $79), you don't need local area network cabling to link your PCs. Instead, this combination lets you use existing power lines that run in a straight path between PCs to carry data, and the setup is more cost-effective than most dedicated network cabling schemes.

The CarrierNET system is able to accommodate up to 255 nodes on a power line up to a mile long. PCs can be located on different floors of a building, assuming that there are no electrical disruptions. Of course, as with any type of LAN, the more workstations on the system—or, in this case, power lines—the slower the response time.

Installing the CarrierNET hardware is simple. You attach one cable from the 1.5- by 3- by 5-inch (HWD) CarrierNET adapter to the power line and the other cable to your PC's serial port via a 25-pin connector. Each CarrierNET adapter contains a small radio transceiver that transmits over power lines. The transceiver employs carrier-sense-multiple-access (listen-before-transmit) protocols to share the radio channel.

After installing the CarrierNET hardware and software, you can then install the optional *ExcellNET* file-sharing and e-mail software. This merely involves answering several questions from a menu.

The CarrierNET system can accommodate up to 255 nodes on a power line up to a mile long.

software uses DOS-like commands, but these must be prefaced with XL (as in XLCOPY), which tells the software to direct instructions through the CarrierNET port.

ExcellNET's user manual is helpful in bringing you up to speed with the program. Unfortunately, there is no manual to walk you through the installation of CarrierNET, although the vendor does offer toll-free telephone assistance.

How does the CarrierNET system perform in a real-world setting? Like many people, we were skeptical of the ability of a power-line transmission system to operate in the presence of high electrical noise, so we did an informal noise test in addition to our performance tests. We plugged an old, noisy, sparking electric drill in the same socket as the CarrierNET module, ran the drill, and performed a file transfer.
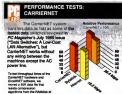
Noise and ozone filled the air, and pulses saturated the power line, but the file-transfer time remained unaffected. Although our test was hardly comprehensive, we believe the CarrierNET's ability to communicate despite this much electrical noise is significant.

Since there is no direct cabling connecting PCs in the CarrierNET schema, the signaling speed is slower than that over wire, which can handle transmissions at 38.4 kilobits per second. In our performance

tests, we recorded an average file-transfer throughput of slightly over 12 kbps for the CarrierNET system.

Currently, the *ExcellNET* software does not support virtual drives; this limits the usefulness of the system, because it cannot provide multiple simultaneous access to the same data files. But even in its present configuration, people who need peripheral-sharing, file-sharing, and e-mail capabilities will find the CarrierNET and *ExcellNET* combination valuable. With better software, the CarrierNET transmission system has a bright future.

PERFORMANCE TESTS: CARRIERNET

The CarrierNET system transfers data as fast as some of the **fastest data** switches reviewed in *PC Magazine*'s July 1989 issue ("Data Switches: A Low-Cost LAN Alternative"), but CarrierNET works without any wiring between the machines except the AC power line.

To test throughput times of the CarrierNET hardware and *ExcellNET* software, we moved a 50K data file that resists compression algorithms from the RAMdisk of one 12-MHz Dell System 200 to the RAMdisk of another. We timed the transfer several times to obtain an average.

Because some PCs cannot operate effectively at over 19.2 kilobits per second through their serial ports, we have provided test results for both 19.2- and 38.4-kbps signaling rates.

Relative Performance
(CarrierNET = 100)

	Relative Performance
CarrierNET	100
Sytelink	80
	64
	40
	32
	16
19.2 Mbps	
38.4 Mbps	

Taller bars represent better performance.

The data switch throughput times shown here are provided for comparison. The same tests are the best of their speed classes, although some data switches using 115.2-kbps signaling achieved faster throughput.

File Transfer Throughput (Kilobits per second)

	19.2 kbps	38.4 kbps
Signaling Rate		
CarrierNET	12.90	23.50
Sytelink	N/A	21.00
Alternet	13.30	N/A

N/A—Not applicable: the device could not be tested at this signaling rate.

First Looks

PageMaker for OS/2: Another Reason to Use Presentation Manager

by Edward Mendelson

With the arrival of the OS/2 version of *PageMaker*, all of the extravagant claims for the Presentation Manager are suddenly vindicated. Aldus Corp.'s Presentation Manager desktop publishing program doesn't do much that you can't do with the *Windows* version of *PageMaker*—it simply does it faster.

At virtually every point where *Windows* users must sit and stare at the hourglass icon, PM users barely have time to blink their eyes before moving on. The difference is so great that those accustomed to the delays in *PageMaker* for *Windows* may find themselves waiting for the hourglass icon to disappear—and then suddenly realize that it was never there at all. The PM version allows you to open multiple documents simultaneously and let one document reformat while you work on another.

Even in a single document, printing, text importing, and text flow between columns and

pages can all proceed in the background while you continue with your work in the foreground. Text loads and flows at about twice the speed of the *Windows* version; other functions show smaller but still-significant improvements. Screen redraw continues in the background also, so you can start work on one page before another

er takes shape on the screen.

The only significant change to the top-line menu is the addition of a *Windows* option, which allows you to switch from one document to another. In the DOS and Macintosh versions of *PageMaker*, you cannot create or open a document while another is on-screen. But if you click on Open or New in the PM version's File menu, the screen is instantly replaced by a second document—and a third and a fourth, up to OS/2's maximum of 16.

Each document looks like a separate session of *PageMaker*, even though you only have to load the program once. You can minimize each document to an

The Windows option in PageMaker 3.0 for OS/2 Presentation Manager switches from one document to another.

icon or tile them across the screen. Any text and graphics that you cut or copy in one document can be pasted into any other with all formatting intact.

The OS/2 clipboard allows cutting and pasting of data between any PM applications. All of the import filters from the *Windows* version—and a few extras introduced after that version shipped—are included in the PM version, and files are fully compatible with the *Windows* and Mac versions.

The only restrictions imposed by the OS/2 version are the limits on output set by OS/2 itself. OS/2, Version 1.1, prints only to IBM dot matrix printers. Version 1.2 includes a limited PostScript driver and works with Epson dot matrix printers. Registered users of *PageMaker 3.0 for OS/2 Presentation Manager* will receive a free upgrade to 3.01, which will include a LaserJet driver. Until then, the best way to print ambitious files is probably through a service bureau.

List Price: *PageMaker 3.0 for OS/2 Presentation Manager*, $795; $95 for owners of the *Microsoft Windows* version. Requires: 6MB RAM; 40MB hard disk; OS/2 1.1 or later; EGA, VGA, or other high-resolution monitor and graphics adapter; mouse. Aldus Corp., 411 First Ave. South, Seattle, WA 98104-2871; (206) 622-5500.
CIRCLE 494 ON READER SERVICE CARD

MacroCalc: Not Your Typical, Clumsy On-Screen Calculator

by Barry Simon

The calculator that comes with *Microsoft Windows* is a nice freebie, but it's inadequate for all but the simplest operations. For business and scientific calculations in the *Windows* environment, Anderson Consulting and Software's *MacroCalc* can be an invaluable tool.

In addition to offering standard and mathematical functions, the

$127 program features a full array of scientific operations, more than ten financial functions, unit conversion, simple statistics, date math, and procedures that make use of its macro language.

MacroCalc displays a graphical representation of a Hewlett-Packard-style pocket calculator; better yet, it even acts like one of these machines, allowing you to work in HP-style Reverse Polish Notation. But this program has a few tricks up its sleeve that take it beyond mere imitation.

First, *MacroCalc* is customizable. You can select from among 13 predefined key layouts, including Financial, Trigonometric, and Statistics,

and can assign these formats or any you've created to 12 soft keys. If you are more comfortable using algebraic notation, a single keystroke will invoke an input box into which you can enter your calculations in conventional notation, even referring by letter to the five registers displayed on-screen.

In addition, *MacroCalc*'s tape system records your calculations in a way similar to the paper-tape printers included with some desktop calculators. You can save a tape to a file, restore it, and reuse it later on.

The program's strength comes from its flexible macro language. You can create macro files, which log a sequence of keystrokes, by simply selecting

the Memorize command to begin the recording process. You also can create and edit macros with the program's built-in editor, *MacroCalc* Edit.

MacroCalc lets you use macros to define functions that should be evaluated, but macros also can serve as the bases for graphs and integration routines. You can paste *MacroCalc*-generated graphs into other *Windows* applications via the Clipboard. Several sample macros come with the program.
List Price: *MacroCalc*, Version 1.1, $127. Requires: *Microsoft Windows 2.03 or later.* Anderson Consulting and Software, P.O. Box 40, North Bonneville, WA 98639; (800) 733-9633.
CIRCLE 488 ON READER SERVICE CARD

First Looks

Microsoft Works 2.0 Adds Windows-like Functionality

HANDS ON
by Jonathan Matzkin

While the debates about *Microsoft Windows* and the Presentation Manager raged, another Microsoft software package quietly established itself as the standard in low-end integrated software. Graphical environments may be the future of truly easy-to-use PCs, but *Microsoft*

Works 2.0 has MS-Windows-like context switching capabilities. You can switch to a window by clicking on it.

Works is here *now*.

In one easily mastered package, Microsoft has combined the four most basic software tools: a word processor, a spreadsheet, a database, and a communications module. Version 2.0 ($149) builds on its predecessor's intelligent design and close integration of components.

Perhaps the most intriguing addition to *Works* is the ability to open up to eight simultaneous windows. You can start a report in the word processor, for instance, and then open a spreadsheet. The spreadsheet appears in a window that you can move or size in much the same way that *Windows* allows. Windows can overlap or completely obscure each other.

The windowing feature gives *Works* a modest form of context switching, which is *Windows'* biggest selling point.

It's not multitasking, and it is limited to the built-in *Works* tools, but there is great value in the ability to move quickly from one application to another without having to close files. To switch from the current window to one that is partially obscured, you simply click on the desired window. It moves to the foreground and becomes active.

You use a pull-down menu to control the movement and sizing of windows; you can handle most of these functions with a mouse, as well. The Arrange All menu choice tiles your open windows so that all are visible and they don't overlap.

The Arrange All feature can make for a busy screen if you have lots of open files, but it's useful for getting a "global" view of your work. It also comes in handy when you lose a window behind several others and don't want to rearrange the whole screen to find it.

Another useful enhancement comes directly from *Word*, Microsoft's high-end word processor. Like *Word*, *Works* can be started either in straight character mode or in "character graphics" mode, which allows on-screen representation of attributes like boldface and italics. The pure character mode maximizes performance on old-

er, slower machines, while the graphical enhancements give users access to WYSIWYG amenities not usually found in integrated packages.

All of these improvements seem to move *Works* toward the graphical future presaged by *Windows* and realized (one hopes) by the Presentation Manager. Other enhancements in *Works*, Version 2.0, are clearly designed to solidify the package's role as a self-contained environment. *Works*—or any other integrated package—is too confining for advanced PC users. But *Works* seeks to provide an all-encompassing solution for the lower-level user.

Toward that end, Version 2.0 allows you to launch DOS applications from within *Works*. That can mean simply shelling out to the DOS prompt, or it can involve running an external application. The typical *Works* user would have little need for external applications, but this feature provides the opportunity for some flexibility.

I easily configured *Works* to launch *XyWrite*, my preferred word processor, and *Procomm*, the communications package I use. With *XyWrite* loaded through *Works*, I was able to load four 19K text files and still have some memory left over.

Basic DOS services are now supported from within *Works*, as well; you can copy and format disks, for instance, without leaving the familiar pull-down menu environment.

Microsoft stumbles a bit when it comes to file conversion. With the wide assortment of word processors currently used in offices, this is an absolutely essential, and increasingly common, feature. *PFS:Professional Write*, from Software Publishing Corp., sets the standard at the low end with its truly transparent conversion

of a variety of file formats.

As shipped, *Works* 2.0 doesn't offer built-in conversion to and from major word processor formats other than *Word*. The documentation includes an order form for the conversion utility—not much help if you need to convert a file on the spot.

Works 2.0 provides some of the functionality associated with *SideKick* and other desktop managers. You can pop up a calculator from within the *Works* applications, and an alarm clock displays a brief on-screen message at a user-specified time.

The enhancements in Version 2.0 also include support for extended memory, a 30,000-word thesaurus, and a limited style-sheet convention for each basic tool.

Good integrated software saves many users from the prolonged pain of learning separate applications. *Microsoft Works* lives up to this standard but also goes beyond it in offering truly useful and powerful tools. Only its lack of good file format conversion deserves serious criticism. At $149, *Works* is an outstanding value. That one outlay covers just about all the functionality that many users will need. One rarely sees that kind of value in software.

Ironically, in bringing *Windows*-like functionality down to this level, Microsoft may be poaching in its own potential market. But some *Microsoft Works* users might eventually make the transition up to *Windows* anyway. ∎

Sometimes even the most advanced technology starts with a simple idea.

Finding a way to make a printer with laser quality, but without laser cost, was no easy task. So when Canon engineers designed the BJ-130, they were quite surprised to find such a simple answer. Bubbles. Millions of tiny ink bubbles, in fact, that quickly and quietly print at up to 360 DPI for performance that's almost unheard of in a non-impact printer.

The BJ-130 Bubble-Jet Printer provides incredibly precise print quality for everything from text to graphics and lets you print on just about any plain paper you choose. Even paper as wide as 16.5 inches,

thanks to a 136-character/line carriage that's the widest in its class.

And when it comes to virtually maintenance-free performance the BJ-130 is also in a class by itself, with built-in automatic cleaning and a unique 48-nozzle print head that lasts for years. Along with high speed operation that's so quiet you can keep the unit right by your desk, convenient cut-sheet feeding plus complete software compatibility, the BJ-130 Bubble-Jet Printer is simply faster, simply quieter, simply clearer. Quite simply, it's a better way to print.

Canon
BJ-130
Bubble-Jet Printer

Zeamon Breathes New Life into Typical DOS Commands

HANDS ON
by Rock Miller

For command-line junkies, *Zeamon* is a handy utility that extends the functionality of the most common DOS commands (COPY, DEL, and DIR) and adds a few that aren't in DOS (such as Move and Update). It runs under both DOS and OS/2 and costs $69.

Zeamon's virtue is consistency. All its commands use the same syntax, and all support the same extended wildcard specification, which lets you include and exclude files by building a filter made up of multiple wildcards. Thus, with *Zeamon*, you can accomplish in a single step tasks such as the following: copy all files except .TMP files, but including PRINT.TMP, in all subdirectories except \TEST. Further, *Zeamon* lets you use the asterisk wildcard at any place in the filename.

A wide range of command-line switches lets you copy from subdirectories and to screen files by date, size, archive bit, and other criteria. Together, these let you do things from the command line for which you would normally need a point-and-shoot-type DOS shell, such as deleting hidden files or moving entire subdirectory trees from one location to another.

Zeamon's advanced features help you handle more-complex jobs. You can put together lists of *Zeamon* commands and filters in a file, called a Speed Zeamon, which can then be used as a kind of command shorthand. *Zeamon*'s List command writes a list of filenames that match the filter criteria to standard output, which can in turn be redirected to a file for use by another application that accepts such lists or piped to another command. And

Zeamon gives you many wildcard and formatting options on common DOS operations.

Execute acts as an enhanced version of the DOS FOR command, giving you a direct way of applying repetitive operations (such as running EDLIN

or DEBUG scripts) to multiple files.

Zeamon's flexibility does have its down side, in the form of picky syntax. You must be

careful to type commands precisely by the book; the program doesn't always warn you if you make syntax errors. You'd be wise to follow the manual's advice to use the /C (Confirm) and /X (eXplain) switches until you're familiar with the program's quirks. *Zeamon* would also be improved by the ability to copy files from more than one directory and by support for more than one DOS error level.

Though most of *Zeamon*'s functions can be duplicated by judicious use of batch files and third-party utilities, who wants to bother? If you spend a lot of time at the C: prompt, *Zeamon* is a worthwhile acquisition. ■

List Price: *Zeamon*, $69.
Requires: 128K RAM, DOS 2.0 or later or OS/2 1.0 or later. Softcare Systems Inc., 925 Clifton Ave., Clifton, NJ 07013; (201) 473-2002.

CIRCLE 444 ON READER SERVICE CARD

Winn Rosch Hardware Bible Offers Comprehensive Hands-On Advice

BOOK REVIEW
by Mitt Jones

While book publishers have been quick to cater to the masses willing to buy yet another book on dBASE or WordPerfect, the collection of PC-related offerings has long lacked a comprehensive guide to the PC hardware. *The Winn Rosch Hardware Bible*, written by one of *PC Magazine*'s most familiar and prolific contributing editors, fills the void nicely.

Comprising over 600 pages of hardware tutorial, the book is divided into 23 chapters, beginning with the motherboard and ending with tape drives. In between, you'll find chapters devoted to topics such as memory, coprocessors, the expansion bus, video adapters, modems, and hard disks, to name a few. CD-ROM and WORM drives are about the only items Rosch doesn't cover.

Rosch's mission seems to have been an ambitious one, akin to being all things to all people. For those who like to

know why their hardware is the way it is, he often begins chapters with interesting accounts of the development and evolution of the component at hand.

For the more pragmatic among us, he sprinkles the book with how-to information. You'll learn, for example, how to replace your motherboard, your power supply, and just about anything else you'd care to remove. One chapter deals with system cases alone. Figures showing DIP-switch settings or part locations often accompany hands-on material.

Of course, no hardware bible would be complete without plenty of down-to-earth explanation, and Rosch devotes the majority of the book to explaining exactly what goes into a PC, what role the components play, and how they work.

The book also serves as a handy quick reference, providing tables on subjects such as hard disk types, Hayes modem S-registers, Epson printer escape sequences, and PC hardware interrupts.
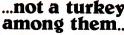
If you've already gained a healthy knowledge of hardware through years of faithfully reading *PC Magazine*, you may be disappointed with the depth of information Rosch provides on some topics. Though by no means a shallow treatment, the book seems to stress breadth of coverage rather than depth. Rosch brings you up to speed on terminology and tells you what you need to know to make intelligent buying decisions. But with a few notable exceptions, he stops short of satiating the truly curious technophile.

Despite its few shortcomings, *The Winn Rosch Hardware Bible* is an impressive achievement and an invaluable source of information for anybody interested in the PC. If you're looking for a hardware primer and reference that is both comprehensive and comprehensible, nothing else comes close. ■

List Price: *The Winn Rosch Hardware Bible*, by Winn L. Rosch, ISBN 0-13-160979-3, $29.95. Brady Books, Simon & Schuster Inc., Gulf + Western Bldg., One Gulf + Western Plaza, New York, NY 10023; call (212) 373-8500 for the book's distributor, Prentice-Hall.

CIRCLE 446 ON READER SERVICE CARD

New&Improved

News of Announced Products and Upgrades

Headlines in a Cartridge Fits Large Fonts into a Small Package

NEW

Boasting a total of 18 typefaces with proportional spacing, $399 Headlines in a Cartridge, from **Pacific Data Products**, includes italic Helvetica and Times Roman in 14-, 18-, 24-, and 30-point sizes, as well as bold Helvetica and Times Roman in 18-, 24-, 30-, 36-, and 48-point sizes. Since the cartridge plugs directly into your laser printer, no additional hard disk space or printer memory is required, and there is no need to download the typefaces.

Furthermore, fonts can be printed in landscape orientation on printers (such as the HP LaserJet Series IID) equipped with an automatic font-rotation feature.

Printer drivers are included for *WordPerfect 5.0*, *Microsoft Word*, *Microsoft Windows*, *PageMaker*, *Microsoft Excel*, *WordStar 2000*, *Ventura Publisher*, *XyWrite III Plus*, and *DisplayWrite 4*.

List Price: Headlines in a Cartridge, $399. **Requires:** HP LaserJet Plus, LaserJet 500 Plus, or LaserJet Series II or IID; Canon LBP-8II; Olivetti PG-108 or PG-208; or compatible printer. Pacific Data Products, 6404 Nancy Ridge Dr., San Diego, CA 92121; (619) 552-0880.
CIRCLE 436 ON READER SERVICE CARD

Headlines in a Cartridge puts 18 large-size fonts on one sliver of silicon.

PRIVATE EYE: A 12-INCH DISPLAY THAT YOU WEAR ON YOUR HEAD

The chief obstacle to shrinking the size of a laptop is the display; Private Eye, from **Reflection Technology**, allows laptop makers to bypass that difficulty altogether by removing the display from the system unit. The miniature monitor, about half an inch across, is basically an extension of the technology behind camcorder viewfinders. When held near the eye or worn on a headset, Private Eye displays what appears to be a 12-inch monitor floating 2 feet in front of you.

Drawing less than a half a watt of power, Private Eye has a resolution of 720 by 280. While Reflection Technology plans to work with other vendors to develop new products based on its system, Private Eye Starter Kits will be available at the beginning of the year for PC users who wish to access and experiment with the technology. Each kit includes an XT/AT-compatible, CGA-compatible Private Eye; a connecting cord; a headset; installation software; and a programmer's guide for Private Eye.

List Price: Private Eye Starter Kit, $495. Reflection Technology, 240 Bear Hill Rd., Waltham, MA 02154; (617) 890-5905.
CIRCLE 437 ON READER SERVICE CARD

Private Eye measures 1 by 1 by 3 inches and weighs all of 2 ounces.

Clarion Offers Two New Modules for Professional Developer

NEW

Clarion Software has enhanced the functionality of its *Clarion Professional Developer* database from **Effective Data Solutions**. This file contains over 40,000 records, each containing geographic information relating to a particular ZIP code.

The $199 *Clarion ZIP Code Language Extension Module* provides developers with the means to create software applications that retrieve, check, and manipulate both specific ZIP codes and data referenced by the codes.

Included with the LEM is the current *ZIP-where* database from **Effective Data Solutions**. This file contains over 40,000 records, each containing geographic information relating to a particular ZIP code.

ZIP code records contain telephone area code, county name, state abbreviation, mileage grid coordinates, city name, time zone, and latitude and longitude for each ZIP code. The records may be accessed randomly or se-

quentially, either by ZIP code or by city name.

The *Clarion LEM Maker* (also $199) is a collection of tools that allows advanced programmers to create their own language extension modules from object modules written in **Borland International**'s *Turbo C*.

Clarion LEM Maker includes a special utility program that creates an assembly language interface between Clarion and *Turbo C* code; two sample LEMs and an extensive library of C functions are also provided.

List Price: *Clarion ZIP Code Language Extension Module*, $199; *Clarion LEM Maker*, $199. **Requires:** *Clarion Professional Developer*; *Clarion LEM Maker* also requires a Microsoft-compatible linker and a Microsoft MASM source-code-compatible assembler. Clarion Software, 150 E. Sample Rd., Pompano Beach, FL 33064; (305) 785-4555.
CIRCLE 438 ON READER SERVICE CARD

New & Improved

Portable GRiDPad Recognizes Printed Handwriting

At first glance, it looks like an overgrown Etch-a-Sketch; if you look a little bit closer, though, you'll see that GRiD Systems Corp.'s new GRiDPad is, in fact, a full-blown, 80C86-based, 10-MHz portable computer that can also recognize printed handwriting.

GRiDPad, designed primarily for PC users who need to gather and record data while out of the office, boasts a 10-inch, CGA-compatible, 640-by-400 display and weighs only 4.5 pounds.

Instead of actually entering information on a paper form, the GRiDPad user writes information directly onto the computer's screen using an electronic pen provided with the unit. (Data can alternatively be entered via a traditional XT-compatible keyboard—not provided with the unit—for those who'd rather type than write.) GRiDPad can capture and store written signatures as well as standard text and graphics.

GRiDPad operates on a single nickel cadmium battery or standard AA batteries.

The unit comes standard with 1MB RAM and can operate for between 4 and 8 hours on a single battery charge, according to the company. Two card slots accept removable 256K ($335) or 512K ($425) battery-backed RAM storage cards, and an optional 20MB external hard disk is also available. MS-DOS 3.3 and

Traveling Software's *LapLink* are built in to the computer's ROM.

List Price: GRiDPad, $2,370; 256K RAM card, $335; 512K RAM card, $425. GRiD Systems Corp., 47211 Lakeview Blvd, Fremont, CA 95327; (415) 656-6700.

CIRCLE 440 ON READER SERVICE CARD

IMPROVED

IBM PS/2 Series Enhancements—IBM has added three new models to the PS/2 series, each a reconfigured version of an existing PS/2. The new 20- and 25-MHz members of the Model 70 386 family—the 70 386-E61 ($5,795) and the 70 386-A61 ($8,365)—can be purchased with a 60MB hard disk with an average access time of 27 milliseconds. IBM's third new entry, the Model 30 286-E31 ($2,565), is a new edition of the Model 30 286, with a 30MB, 27-ms. hard disk. IBM has also increased the standard memory configuration on all versions of the Model 70 386 and the 30 286 from 1MB to 2MB. IBM Corp. (contact your nearest authorized IBM dealer); (800) IBM-2468.

The Norton Commander, Version 3.0—The latest release of *The Norton Commander*, the popular DOS manager from Peter Norton Computing, features an expanded list of *file viewers*, which allow users to quickly view files in their native formats without having to load the specific applications. Version 3.0 of the *Commander* can view 22 common file formats, including those used by Microsoft Word, WordPerfect, and PC Paintbrush. New features include Commander Mail, which allows users to send and retrieve electronic messages and binary files via MCI Mail, and Commander Link, which gives users the ability to transfer files between any two PCs via a serial cable

The Quick View option of *The Norton Commander*, Version 3.0, lets you browse through the contents of the files on your hard disk.

(available from the company for $29.95). Quick View, an enhancement to the DOS shell, enables a PC to display a directory of files on one side of its screen and the contents of a highlighted file on the other side. Once the desired file has been located in the directory, the program's Point and Shoot operation enables both data and application to be loaded with a single keystroke. Version 3.0 of *The Norton Commander* retails for $149. Current owners can obtain the upgrade for $49, plus $5 for shipping and handling. Peter Norton Computing Inc., Santa Monica, Calif.; (213) 319-2000.

SeeMORE, Version 2—Personics Corp.'s enhanced version of its spreadsheet utility package, *SeeMORE*, gives users working in Lotus 1-2-3, Release 2.x, or Symphony, Version 1.x or 2, the ability to create an unlimited number of windows on-screen, allowing for easier manipulation of different segments of a worksheet. Windows can be tiled or overlapped, and attributes such as column widths, hidden columns, and insert and delete operations can be set independently for each window. Changes in one window will result in updates of all dependent windows and graphs, and a Restrict Ranges option is offered to limit cursor movement and insert and delete operations within the individual windows. Live graphs and horizontal rule lines can also be displayed

New & Improved

PixSure Lets You Turn a .DBF File into a Graphics Database

NEW

It can be considered one of the ultimate database features: linking pictures to textual information. To instantly have at your disposal not only a wealth of data on a certain subject, but also a good visual representation of that subject as well.

PixSure File Pictorial Database, from Norick Data Systems, is a source-code generator that lets you add high-resolution video pictures (captured from any NTSC signal source, such as a still video camera, camcorder, or television) to any .DBF format database. Using the *Clipper* compiler to generate code, *PixSure File* can either create a standalone database file or attach images to a preexisting *dBASE III+* file.

Images can be stored and viewed in a variety of sizes, from quarter-screens to full

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IMPROVED

on-screen, and EGA- or VGA-equipped users can change the colors of more than a dozen screen elements. *SeeMORE*, Version 2, retails for $99.95. Current owners can obtain the upgrade for $25. Personics Corp., Maynard, Mass.; (508) 897-1575.

Sigma-Plot, Version 4.0—Jandel Scientific has enhanced its scientific plotting software package, *Sigma-Plot*, and has integrated pull-down menus into its user interface. *Sigma-Plot*, Version 4.0, offers users a new set of specialized scales, including probit, logit, probability, and natural log; extended symbol choices; more specialized graph types, including stacked bar charts, box plots, quality control graphs, and pie charts; and greater flexibility with error bars. The package also features a data worksheet of up to 16,000 columns (expanded from 128); user-variable column widths to accommodate the required precision of data; new data-analysis operations, including *t*-tests; and a mathematical transform language that enables the user to enter and plot nearly any equation. Output options have also been enhanced and expanded: a greater number of fonts are provided, variable line thicknesses are possible for individual graphical elements, and line- and figure-drawing capabilities have been added. *Sigma-Plot*, Version 4.0, is available for $495. Contact the company for upgrade details. Jandel Scientific, Corte Madera, Calif.; (800) 874-1888, (415) 924-8640.

Sigma-Plot, Version 4.0, incorporates pull-down menus and has improved graphing capabilities in its user interface.

Microsoft Mouse 400 Series—The Microsoft Mouse now boasts a resolution of 400 points per inch, up from 200 ppi. The new device, the Microsoft Mouse 400 Series, retains the design of its predecessor and houses all of its necessary electronics internally, thus doing away with the serial interface module. In addition, a new accelerator algorithm enables the on-screen cursor to move at a rate directly proportional to the velocity at which the mouse is traveling. As the user accelerates the mouse, the cursor will move a greater distance; conversely, as the mouse decelerates, the cursor will move a smaller distance. Through the Control Panel, any one of three predefined levels of acceleration can be selected, or the user can customize the mouse to his or her own rate of acceleration. Drivers for both OS/2 and DOS are included. The Microsoft Mouse 400 Series is available in two interface versions: bus and serial-PS/2. Prices are $150 bundled with *Microsoft Paintbrush* and $200 bundled with *Microsoft Windows/286*. Microsoft Corp., Redmond, Wash.; (206) 882-8080.

PixSure File

CONTINUED FROM PAGE 56

screens. According to the company, over 3,200 full-screen images, or 8,300 quarter-screen images, can be stored on a 100MB hard disk.

Other features of *PixSure File* include mouse support for the program generator and all generated databases; pull-down menus; support for character, numeric, decimal, logical, and date fields; full support for indexing facilities; on-line help; label rotation and editing facilities; and support for .PCX-format files.

PixSure File supports both VGA and Targa16 graphics capture boards. According to the company, future releases of the package will have the ability to generate C, BASIC, Pascal, and standalone .EXE files. **List Price:** *PixSure File Pictorial Database*, $995; with Jovian Logic graphics capture board, $1,495. **Requires:** IBM PC AT, PS/2, or compatible; 640K RAM; hard disk; 1MB EMS memory; Microsoft or compatible mouse; VGA or Targa16 graphics capture board (for software-only version); DOS 3.1 or later. Norick Data Systems Inc., 5400 NW Grand, #450, Oklahoma City, OK 73112; (800) 521-EASY, (405) 947-7560.

Filter Packs Enhance GEM Applications' Import Capabilities

NEW

Users of many popular graphics packages, such as *Freelance*, *Harvard Graphics*, and *PC Paintbrush*, now have access to GEM-based applications that also speak their language.

Digital Research's collection of $15 *Filter Pack* programs allows users to convert .PIC, .PCX, .TIF, .DXF, and .CGM files to GEM format from the DOS command line. Each *Filter Pack* supports one file format and will work with any GEM application, including *Ventura Publisher*, *Draw Plus*, and *GEM Artline*. In the case of *GEM Desktop Publisher*, the newly supported files may be read directly into the application. **List Price:** *Filter Pack*, $15 each. **Requires:** Any GEM-based application. Digital Research Inc., Box DRI, Monterey, CA 93942; (408) 649-3896.

Our PC CACHE can accelerate disk intensive applications dramatically.

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n of utilities.

dows, full mouse support, pull-down menus and context sensitive help make learning and using the product a breeze. And PC Tools Deluxe conforms to IBM's Systems Application Architecture (or SAA) standards so its look and feel is almost identical to all the other applications you'll see in the 90s.

PC Tools Deluxe. It has redefined what a utility product should be. Designed not only to protect you from misfortune, but to make using your computer as fast and easy as it should be. So, even if you never have had an accident in your entire life, you'll still benefit from PC Tools the very moment you start using it.

PC Tools Deluxe 5.5
Central Point Software INC
A MEMBER OF THE VERY TECHNOLOGY GROUP ● (503) 690-8090

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Pipeline

A Look at the Trends Shaping the Personal Computer Market
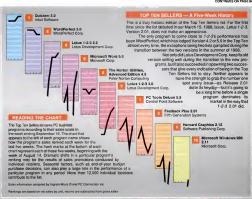
Microsoft and Apple Gang Up on Adobe; PostScript Specs Slip into the Open

Faced with the prospect of being trampled by two giants, John Warnock, president of Adobe Systems, appealed to the court of public opinion with a bold and risky move last month. After spending years building a proprietary standard for defining how to print typefaces and graphics on a wide range of output devices, Adobe will unveil the inner workings of PostScript early next year, according to Warnock.

Warnock is changing Adobe's successful (and highly profitable) course only under extreme duress, of course. He's faced with a Microsoft-Apple alliance that was formed for the sole purpose of wresting control over high-end laser printers away from Adobe's page description language (PDL), PostScript.

Not only have Microsoft and Apple been unhappy about paying royalties to Adobe for its technology, they also feel vulnerable; both companies would rather have their own programmers hammering away at PDL drivers instead of waiting to it. Smaller software publishers and printer makers have been grumbling about Adobe's high rates for some time, and clones of the language have been marketed with small success, but this is the first real challenge to Adobe's dominance since Apple's LaserWriter and Aldus Corp.'s PageWriter and Aldus Corp.'s PageMaker on the Mac started talking to each other through the PostScript interpreter—a

TOP TEN SELLERS — A Five-Week History

This is a truly historic edition of the Top Ten Sellers list. For the first time since the list debuted in our March 15, 1988, issue, *Lotus 1-2-3*, Version 2.01, does not make an appearance.

The only program to come close to 1-2-3's performance has been *WordPerfect*, which has lodged Version 4.2 or 5.0 in the Top Ten almost every time, the exceptions being two lists compiled during the transition between the two versions in the summer of 1988.

Not only did Lotus Development Corp. keep its old version selling well during the transition to the new programs, but it also succeeded in spawning two successors that give every indication of being in the Top Ten Sellers list to stay. Neither appears to have the strength to grab the number one spot every issue—as Release 2.01 did in its heyday—but it's going to be a long time before a single program dominates its market in the way that *1-2-3* 2.01 did.

1 Quicken 3.0
Intuit Software

2 WordPerfect 5.0
WordPerfect Corp.

3 Lotus 1-2-3 2.2
Lotus Development Corp.

4 Microsoft Word 5.0
Microsoft Corp.

5 The Norton Utilities, Advanced Edition 4.5
Peter Norton Computing

6 Lotus 1-2-3 3.0
Lotus Development Corp.

7 PC Tools Deluxe 5.5
Central Point Software

8 Fastback Plus 2.01
Fifth Generation Systems

9 Harvard Graphics 2.12
Software Publishing Corp.

10 Microsoft Windows/286 2.11
Microsoft Corp.

READING THE CHART

The Top Ten Sellers list ranks PC business programs according to their sales totals in the week ending September 16. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of August 14. Dramatic shifts in a particular program's ranking may be the results of sales promotions conducted by individual retailers. Seasonal factors, such as end-of-year budget purchase decisions, can also play a large role in the performance of a particular program in any period. More than 12,000 individual locations contribute to the list.

Sales information compiled by Ingram-Micro D and PC Connection Inc.

Rankings are based on net sales by unit, returns are subtracted from gross sales

Pipeline

rapport that created the concept of desktop publishing.

Of course, after Adobe takes the wraps off PostScript's inner workings next year, no one will have to depend on Adobe. Ironically, Microsoft says it's still going to stay its course with Apple rather than attempt to make peace with the language's creators.

Adobe will have to prove that it can make superior use of its own language in software drivers and printer ROM controllers to keep the company thriving. Early word is that the Microsoft-Apple emulation is several times faster than Adobe's, but a real product is many months away.

Apple's Change of Heart

Adobe's success with PostScript has been nothing short of breathtaking in the last couple of years; PC software, desktop laser printers, and top-of-the-line page-composition systems settled on PostScript as a common choice. HP's LaserJet-based PCL is the most popular way to print standard office documents today, but even among $2,000 laser printers, the future trend is toward PostScript on font cartridges. (Adobe-licensed PostScript cartridges should be available for less than $1,000 by the end of the year; PostScript clone cartridges are available for less right now.)

The company's hand was forced by the combination of Microsoft's unwillingness to pay royalties for the use of PostScript in OS/2 and Apple's change of heart. (Apple severed its long relationship with Adobe earlier this year for reasons that are still mysterious but that may have something to do with Adobe's budding relationship with Steve Jobs's NeXT industry.)

In searching for its own font-printing technology, Microsoft had acquired a tiny company, Bauer Enterprises, that had cracked most of Adobe's secret font-hinting techniques (the algorithms that make best use of a printer's fixed number of dots in depicting smooth and precisely drawn characters).

A new way to control fonts has long been needed for OS/2 (see the June 13, 1989, Pipeline). It had seemed that Microsoft would create a new technique for displaying and printing both characters and graphics. Now, by emulating a successful standard, Microsoft is opening up a PDL clone market in the same way that Phoenix Systems broke IBM's PC BIOS wide open.

The one ingredient that both sides still must get from a third party is the typefaces. Adobe's typefaces are sold under license from Agfa-Compugraphic, Bitstream, and Linotronic; all three now say they'll cooperate with Microsoft and Apple while continuing their relationship with Adobe.

The prevalence of PostScript on PCs has helped these three companies gain royalties from the growth in desktop publishing, so they'll support any scheme that puts their typefaces on a greater number of printers.

At Least a Year Away

It's hard to say how long it will be before you're able to get true WYSIWYG PostScript applications because Microsoft doesn't expect to wrap the technology into OS/2 code until Version 2.0 at the earliest (OS/2 1.2 is just now being completed), but it's probably a year away.

Since Microsoft expects that its implementation will be fully compatible with today's PostScript printers, these new developments only confirm the value of PostScript as the preeminent printing standard for today and for the future.

They also prove yet again the strength of an established standard in the PC market — and the frailty of standards ownership.

∎

> Early word is that the Microsoft-Apple emulation is several times faster than Adobe's.

Some foresight into remote computing hindsight.

Hindsight is always 20/20. And it's always too late. Especially if you've spent a lot of money on remote access software with limited features.

Use some foresight. Compare the features of the various packages up front, and the choice will be clear – pcANYWHERE™ III beats the competition hands down. And you'll never have to look back with regret.

But don't just take our word for it. Publication after publication – including the only Editor's Choice for Remote Computing from *PC Magazine* – have cited pcANYWHERE III as the finest remote computing software on the market today. Bar none. It's faster, easier to use and contains features that just can't be found in any other package.

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Bill
Machrone

However hot today's battles may be, rapid change ensures that they just won't matter in the end. And the end will come sooner than you think.

Fred Astaire was, for many, a living symbol of urbanity and civility. And his personal style wasn't far removed from his screen image. My favorite Astaire story has him in a bar when two patrons begin brawling. Astaire, ever the gentleman, saunters over to the combatants, places his hands on their shoulders, and says, "Come on, fellows, what will it all mean in a hundred years?" Both men angrily turned on Astaire for so trivializing their travail.

Astaire's role, and the fighters' anger, isn't all that different from the acrimony that results when people attempt to select appropriate technology from the vast array of choices the market offers. Today's platform wars are destined to become insignificant—not in a hundred years, but in ten years, or even five.

Any industry that, like the PC industry, regards a year of 15 percent expansion as slow is definitely in hypergrowth mode. Even zero growth would put about 7 million new machines into the market in 1990. And hypergrowth is accompanied by hyperchange, with replacement technology emerging as frequently as every 12 to 14 months. Unlike the artificial cycles created by Detroit, these are real changes—everything is getting faster, cheaper, and higher in capacity.

The PC is evolving from a handy and productive business tool to an agent of social change. And it's doing so at such a breathtaking rate that many of us are having difficulty keeping up with it. We must absorb the PC industry's phenomenal outpouring of technology or weather the guilt that comes from the knowledge that we're behind the technology curve.

SUSPICIOUS SUPERLATIVES

Prefixes such as *hyper-* and *mega-* tend to bring out the cynic in me. Yet I've sniped on fully for hyperchange in the PC market. The user market is divided into three groups: the haves, the have-lesses, and the have-nots. At *PC Magazine*, we have positioned ourselves as a chronicler of the haves. This irritates the have-lesses because it forcefully reminds them that their systems are not only obsolescent but also overpriced.

One thing the haves and have-lesses can agree on is the pitiful plight of the have-nots. At today's prices, no business professional need be without a PC. Yet many still spread their arms and ask, "What do I need one for?" Some have-nots are technophobic. Others simply can't type. And still others are waiting for an application that has more bearing on their jobs, a view with some validity. For the last group, local area networks will deliver the message forcefully. These have-nots will be unable to participate in their workgroups, whether as workers or supervisors, unless they use PCs.

Not since the introduction of the automobile have there been such dislocations over a product. Yet we look back at those early days of automotive confusion with bemusement and a faint sense of superiority. After all, time was when directional signals were illegal, some argued for bells instead of horns, and early automotive enthusiasts were greeted far and wide with the cry "Get a horse!"

Today, no one questions the role of the automobile in decentralizing America, whose overcrowded, manure-paved cities would otherwise have choked. Decentralization is necessary for growth, and rapid decentralization is necessary for hypergrowth. This magazine owes its existence to hypergrowth, and to its readers' insistence on knowing all of the alternatives that are available to them in their

ILLUSTRATION: ROBERT PASTERNAK

Bill Machrone

struggle to deal with change.

One of our most loyal and outspoken readers, Ken Ganshirt, works for one of the Canadian telephone giants. He's worked his way out from the highly citified mainframe shop to the urban minicomputer to the decidedly suburban and individualistic PC.

"We've always followed the technology up rather than the pricing down," says Ganshirt. "Senior management now expects us to stay with the current technology as soon as it is stable and at our price point (which we've pushed up a bit from the early days). This has served us well. When business users are ready to take advantage of the next levels of functionality available, the necessary platforms are there."

THROWAWAY SYSTEMS
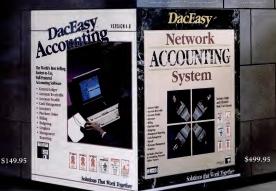
In some companies, this thinking has progressed to the point where PCs are regarded as consumable goods by the system builders. They design a system to accomplish a goal and to save money right now. They think of the PC not as capital equipment, but as an investment. They reap its financial benefits and then scrap it. They don't wait for standards; they capitalize on results.

Of course, "scrapping it" has a different meaning to the micro managers than to the accountants. Nobody's seen a PC go out in the trash yet. PCs get redeployed, perhaps half a dozen times. The forward thinkers don't worry about whose department is taking the depreciation or whether they've exhausted a given department's capital budget.

The key to success is balancing the needs of workgroups against the fiscal needs of the company. Micro managers are faced with an incredible array of choices, from cheap old technology to expensive new technology. They've got to balance what's installed against what's available against what's affordable.

PC Magazine will continue to do its part by concentrating on the leading-edge technologies. You don't need us to rehash old choices, and you don't need us to reconfirm the decisions you've already made. We'll continue, instead, to refine the comparative review, with the goal of making this magazine even more dense and information-rich. ∎

John C. Dvorak

Feeling a little lousy lately? Maybe it comes from "waiting till next year" for panaceas that never materialize.

It's called Presentation Manager Syndrome, PMS for short. It causes all sorts of problems for the afflicted. Nervousness, headaches, cramps, irritability. In short, PMS is the preannouncement or promise of something better than the bug-ridden product you are using. This promise is actually an excuse. The end user is the one who gets the headaches and cramps.

This isn't a new syndrome, though it seems to have climaxed during the recent two-year-long wait for Presentation Manager as the be-all, end-all, cure-all killer front end that will make OS/2 a knockout success.

It actually goes back to the days of CP/M and the S-100 bus. In the 1970s, when users had complaints, they were told not to worry, the new CP/M-Plus and the S-100 bus IEEE-696 standard would solve their problems. When CP/M-Plus finally came, the IBM PC was on its way to making history. By the time the S-100 bus was standardized, nobody cared.

Software vendors have always relied on such stalling tactics to string along the hapless user. The next bug fix is always "just around the corner." Recently, for instance, I had the unfortunate experience of trying to migrate to *Microsoft Windows/386*. I soon ran into one of those peculiar bugs that you always find in software whose target machine is actually a slew of machines, each of which is slightly different. My Everex 386 uses a Compaq video card, and I got a wacky configuration-error message after watching *Windows/386* work just fine for about a day. The factor that changed and made the error message appear was never discovered.

Anyway, I moan about this to an ex-Microsoft acquaintance, who decides to help me. He calls some of his *Windows* buddies at Microsoft to find out what's wrong. First off, we discover that some of the offending code was actually contributed by Compaq. "They screwed it up," I'm told. Microsoft, of course, is blameless. Then I'm told that Microsoft actually writes with the Compaq as the target machine. Interesting fact, I think to myself. Nevertheless, part of this code doesn't like the Compaq VGA card. What to do, what to do?

Finally, my friend gets off the phone and says, "Do you want me to tell you what you should really do? They say to wait for *Win-*

dows 3.0. It solves all these problems." *Windows* 3.0? Slowly . . . step by step . . . inch by inch—PMS!

BAD MEMORIES

This wasn't my first experience with *Windows*-induced PMS. It reared its head when I complained about the ugliness of *Windows* and got a memo from Machrone, who said, "Are you sure you want to say these bad things? They'll be corrected in *Windows 3.0!*" Arrgh. Cramps. Nausea. I also got it when I griped about how *Windows* does such a poor job of running straight DOS applications. I was told, "*Windows* 3.0 will improve it!" That created gas, the shakes, and two pimples.

I don't want to sound like I'm picking on poor little rich Microsoft. Other sources of PMS are everywhere, the long waits for *dBASE IV* and *Lotus 1-2-3*, Release 3.0, being prime examples. The difference, though, is that these products were never talked up as ultimate fixes for some sort of bug or irritation. Instead, they

are being sold as killer "makeovers."

Now we all know what a makeover is like, right? Remember *Symphony*? It was rolled out as the ultimate killer app—better than *1-2-3*. And remember *Framework*? It was sold as the killer makeover that would supplant *dBASE*.

Meanwhile, my advice for those of you who get headaches from endless promises of wonderful future improvements: take two aspirin. And get some sleep. ∎

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John C.
Dvorak

Inside Track

While all the programmers in the world talk about C and Pascal and all their OOOPS or WHOOPS modifications, we forget the importance of BASIC—the language that launched the microcomputer revolution. It seems to have gotten lost in the shuffle, although Digital Research's DR-BASIC (whatever happened to that?) and Turbo Basic from Borland have made brief appearances.

The dominance of QuickBASIC, from Microsoft—perhaps one of the **greatest software packages** ever written—may actually have **ruined interest** in BASIC. After all, there is no longer any controversy or discussion on the subject of BASIC. Few observers have even noticed the lack of a BASIC for *Microsoft Windows*, despite the fact that *Windows* has been out for years.

The original Altair BASIC was written from scratch by Bill Gates and Paul Allen in less than a year. So one assumes that the **hordes** of Microsoft programmers could easily do BASIC for *Windows*, especially since they can use the already complete Microsoft BASIC code as a starting point. All that this says to me, therefore, is that *Windows* is **incredibly difficult to write for**. I mean, even Microsoft can't do it.

Then again, the problem may lie elsewhere. It's obvious that all programs whose roots go back years and years are continuously modified until they turn into what's known as spaghetti code—an **undecipherable, convoluted mess**.

So it's amusing, but not surprising, to discover that Ethan Winer and his full-time staff of five can make a decent income supporting Microsoft QuickBASIC with add-ons, utilities, and improvements. The **talk of the programming community** is a replacement for the QuickBASIC library marketed by Winer's company, Crescent Software, of Stamford, Connecticut. It's called PDQ.

The company blurb says, "By removing the excessive hand-holding that QuickBASIC normally adds, PDQ programs can be nearly as small and fast as if they were written in assembly language. What makes most BASIC programs so large is the mandatory error checking that is present in the BASIC language library. By completely replacing that library, we are able to achieve extremely fast and small .EXE files—much smaller than C, and even competitive with assembly language."

PDQ also allows you to **turn any BASIC program into a TSR!** Fully executable .EXE files can be compiled down to as little as 690 bytes! If you think BASIC is dead, you'd better check out this $99 software package from Crescent. Phone them at (203) 846-2500. **Hot stuff,** for sure.

> "Should we format the diskettes all at once? OK, but only six fit in the slot at one time!" Gads!

Software for the Rest of Us Dept.: Those of you who don't want to get too involved in BASIC or any kind of real programming but would like to impress the boss with a little compiled code once in a while should check out BATCOM. It's great. This nifty product will **take any DOS batch file** that you write and turn it into an executable file that runs up to **four times faster** than the old .BAT file. Developers who rely on dopey batch files for demos or installation programs might consider using this package to clean up their acts. It also keeps prying eyes out of your batch files.

BATCOM is from Whenham Software, 5 Burley Rd., Whenham, MA 01984; (508) 774-7036. It costs $59.95 and includes an extended batch language for those who want to get carried away. It also provides you with a bunch of **interesting** compiled utilities. If you write a batch program that won't compile properly, the company will gladly help you, too. This is definitely a fun product.

Crazy Mistakes Dept. Redux: I got a letter from Jeff Drew with more "Crazy Mistakes." I couldn't wait to run them in the next installment of Crazy Mistakes, so here they are: "John, I loved your articles on Crazy Mistakes—the crazy but true experiences in the computer business. I've got a couple for you. The latest rage is 386 CPUs in a tower configuration, right? Well, I know a guy whose German Shepherd mistook the office 'tower' for a hydrant and cost the guy a **small fortune** in repairs.

"Then there's the one about the guy who unplugged the cable and kept one end higher than the other end so that the current wouldn't run out. And how about waiting for solder to dry! Should we format the diskettes all at once? OK, but only six fit in the slot at one time! When I loaded all my programs into memory and turned the machine off, they were still there; how do I get them out? Not so funny: a $100-million bank says it last backed up about a month ago. And then there's the expert who says, 'I only keep programs on my hard disk; data files are for diskettes!' " Gads!

Old News Dept.: Has anyone wondered about the federal ruling nearly a year ago in the NEC-Intel lawsuit concerning microcode copyrights?

According to recently published reports, "U.S. District Judge William Gray also ruled in the same case that a Japanese manufacturer legally copied microchip designs from a U.S. company." Apparently, Intel failed to protect its copyright of the 8088's innards because of some legal technicality. I wonder exactly why AMD or some other chip maker hasn't **cloned** the chip and made it run at 25 MHz. Is anyone aware out there? ∎

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1-2-3 Release 3 lets you manipulate data, navigate through complex applications, and work with more speed, power and ease than any other spreadsheet.

In fact, *InfoWorld* recently was moved to say "…with this new release, 1-2-3 has instantly regained its long standing position as the sheet to beat."[1]

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Equally impressive is Release 3's presentation quality output and its range of advanced analytical graphics. In addition, our new programming tools make custom

Jim
Seymour

Market trends notwithstanding, the days of the 286 are numbered. And Intel's new low-power version of the 386SX will put the last nail in its coffin.

Today, there is no defensible reason for buying an 80286-based desktop PC for use in business. And by about this time next year, there will be no defensible reason for buying an 80286-based laptop PC for use in business, either.

Them's my premises. Now let's argue 'em.

First, let me acknowledge that my view appears to be out of sync with what the market says. In *PC Magazine*'s review of new 12-MHz 286s a couple of months ago ("286s: No Frills, Few Thrills," September 12, 1989), the market research graphs on page 160 showed that the popularity of 286 PCs is growing, not declining.

The Dataquest chart says that 39 percent of the 1988 market for corporate, education, and government PCs was claimed by 286s, with 386s and 386SX machines picking up only 9 percent. A second pie shows Computer Intelligence's forecast for 1989 sales to the same markets, in which 286 machines jump to 51 percent of the market, while 386s and 386SXs creep up only one point, from 9 percent to 10 percent.

It's always problematic to compare data from two different sources. But the trend is clear: sales of 286s are soaring, while sales of 386s are merely increasing nicely, thank you.

Beyond the data that says the market is voting the other way, there's a second, equally irrelevant argument against me: very little 386-specific software is available today.

That would be a Big Deal if we were buying PCs today for use *only* today, and maybe tomorrow and next week and next month. But the companies I work with buy PCs on a three- to five-year time horizon. They expect to be able to use their computers fully for three years—which means using them to run the important new software that comes out over that time. And then they expect to go through a couple of years of reevaluation and handing down, selling the machines off to employees for home use.

I can promise you that over the next three years, the hot software is going to demand 386 PCs. In some cases you'll be able to kludge through with a fast 286 and lots of memory. But memory is expensive, and no matter how quickly today's 1-megabit DRAMs give way to 2Mb and 4Mb parts, memory is *always* going to be expensive.

So why stick all that expensive memory in a crippled machine, driven by a brain-dead chip? Especially when that machine was only marginally less expensive than a 386 machine in the first place.

UNLEASHING THE POWER

The importance of 386 PCs is going to become even more evident early in 1990, when Microsoft ships *Windows* 3.0. On a 386 PC, its vastly superior memory management will finally pull *Windows* into the mainstream, fulfilling (if years late) the forecasts that we're on our way to a world of graphical user interfaces.

And by late next year, we should see the 386 version of OS/2 with Presentation Manager—a.k.a. "real OS/2." That will also have a big impact on the business-PC market.

Even if you don't succumb at first to the charms of a graphical interface, you'll benefit from the raw speed of these faster machines. Which is the other reason we should stop buying 286s and start buying 386s, *now*.

I run only a couple of applications that directly exploit the advantages of the 386 chip. But my 386s run *386-to-the-Max*, a memory management utility, and the *Super PC-Kwik* disk cache. Always loaded at start-up from my AUTOEXEC.BAT file, those two utilities work together to create—only on a 386—a spec-

ILLUSTRATION: ROBERT PASTERNAK

Jim Seymour

tacularly fast, easy-to-manage workspace for *all* my DOS applications.

THE PRACTICAL 386 LAPTOP

I said that by this time next year, there won't be any good reason to buy a portable PC that doesn't have 386 power. The key here is Intel's low-power version of the 386SX chip.

Last April, Intel announced and shipped the first 386SX-LP, a special low-power version of the 386SX chip. It offers a new power-conservation mode—in effect, a "nap mode"—in which the chip is slowed down to 2 MHz, for power savings of up to 30 percent.

Equally important, the 386SX-LP is spec'd to run in environments with temperatures up to 100 degrees C., of critical importance in the tight, hot confines of a laptop case.

We haven't seen much use of that 386SX-LP power-conservation feature yet. But we will, beginning with machines that will make their debut at this fall's Comdex show.

But the real winner—you read it here first, folks—is going to be a new version of the 386SX-LP, which will go into production at Intel later this year.

By moving from the CMOS III process, which uses 1.5-micron-wide traces on the chip, to the new CMOS IV process, which uses incredibly fine 1-micron traces, Intel will be able to offer that 30 percent savings in power consumption while running the chip at its full rated speed of 16 MHz.
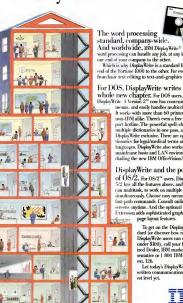
Intel has also promised a 20-MHz 386SX-LP for sometime next year. That's interesting, but not nearly so interesting or important as this new, truly lower-power 386SX.

Attentive readers may complain that I'm singing a very different tune than I was as little as 15 months ago, when I wrote here that Harris's then-new 20-MHz 286 proved that the 286 design still had a lot of life left in it.

True—but again, irrelevant. Times change. After all, eight years ago, I was raving about the virtues of the 8088 chip.

The "386 imperative" isn't yet so strong that American business needs to retrofit or discard its existing fleet of 286 PCs—though that day is approaching. But it's clear that the time has come to stop buying new ones. ■

William F. Zachmann

It's fashionable these days to run down OS/2's prospects. But for those with eyes to see, the big move is happening now.

To those who can read the signs in the computer industry the way Daniel Boone read the signs in the woods, it should be clear that the shift toward OS/2 is now under way. Those who can't spot a trend until it is writ large on the billboard of major market surveys, however, are having a hard time seeing what's going on.

There are lots of reasons why the city slickers of the industry, unable to find their way without a road map, aren't yet able to discern the shift in the weather. Mainly, though, it's because they're operating on false assumptions about what it takes to make the move to OS/2 worth doing.

Two months ago I noted in passing that there are two major requirements for OS/2 to get rolling (*PC Magazine*, September 26, 1989): first, it must reliably furnish all the capabilities already available from DOS; and second, it must offer enhanced capabilities sufficient to justify the added expense and effort required to use it.

Those who claim that significant use of OS/2 is still years away, that *Microsoft Windows* will dominate the market for the next several years, that programs like *DESQview* and *386-to-the-Max* will remain better alternatives for multitasking existing DOS programs, that the introduction of *Windows* 3.0 will make OS/2 unnecessary, or that Unix will take over the desktop arena are all off the trail. Their assumptions have led them astray.

The first misleading assumption is the myth of the "killer app." According to this view, simply doing what DOS already does doesn't justify the cost of the upgrade. People won't move to OS/2, it is assumed, until some spectacular new application that makes full use of OS/2's capabilities comes to market.

In fact, word processors and spreadsheet programs are the applications that real people spend most of their time using. Add database, graphics, and communications packages to the list and you've accounted for something like 90 percent of personal computer use.

These "big five" were the main applications of early CP/M computers. They are the main applications on IBM-compatible PCs and Apple Macintoshes today. And they will

be the main applications on OS/2 computers tomorrow. We didn't need a brand new "killer app" to move from CP/M to MS-DOS, and we won't require one to move from DOS to OS/2.

For it isn't the ability to do brand-new types of applications but the ability to do the old types of applications better that will justify the switch to OS/2. The "killer apps" won't be entirely new types of applications at all. Instead, they will simply be better spreadsheet, word processing, communications, graphics, database, and utility programs, offering more power, more speed, and greater ease of use than their DOS counterparts.

A LITTLE HISTORY LESSON

Those with short memories and a distorted sense of history sometimes cite *Lotus 1-2-3* as the stimulant for the move from CP/M to DOS. In fact, the movement to DOS was well under way when *1-2-3* was announced. The program did bring about a better way of doing things in

the already established category of electronic spreadsheets by making better use of the enhanced capabilities of DOS and the 8088. It was not, however, the reason that DOS became a success.

Today *1-2-3*, Release 3, already offers an OS/2-capable spreadsheet, and other spreadsheet vendors will soon release their own OS/2-based products. OS/2 versions of existing word processing, communications, data-

William F. Zachmann

base, and graphics programs are also available today, with more competition on the way. And new programs in these categories—programs that make full use of OS/2's advanced capabilities—can't be far behind.

The city slickers also fall down in their assessment of the costs of moving to OS/2. They assume that thousands of dollars in added hardware and software will be required. What they fail to recognize, however, is that not everyone is starting out with a 10-MHz 286 system with only 1MB of RAM and 20- or 40MB of hard disk space.

If everyone had a 286 and wanted to move to OS/2 Extended Edition, the costs would be quite high. But many users already have 386 systems with 100MB of hard disk capacity and 4MB or more of memory. And the vast majority of OS/2 converts are heading for the Standard Edition, not the Extended Edition.

For this reason, the "DOS forever" scenario is *way* off base. A system that can really put *DESQview 386* or *Windows* 3.0 to work is perfectly capable of making effective use of OS/2 Standard Edition. In fact, it will be these power users who will most likely be the first to switch to OS/2. Not only do they already have systems that can run OS/2, but they also have demonstrated a clear interest in the capabilities that OS/2 can offer.

Similarly, the argument that *Windows* 3.0 muddies the waters and will slow the movement to OS/2 fails to withstand the test of reality. On the contrary, *Windows* 3.0 makes the transition from *Windows* to OS/2 easier. It will help accelerate the acceptance of both *Windows* and OS/2 by creating a smoother bridge from older, less-capable DOS systems.

Yet another set of wrong assumptions concerns OS/2's ability to run DOS applications in the compatibility box. Lots of people who have little or no direct experience with OS/2 like to refer to it as the "penalty box," evoking vague concerns about its stability.

In fact, as anyone can verify simply by using OS/2 for a little while, the compatibility box causes very few problems in running DOS programs, including communications programs. *None* of the many DOS applications I use regularly has had any problem running under OS/2.

If those who are still mired in the swamp would simply look about them, they would quickly realize that they are underestimating OS/2 today just as surely as they overestimated it two and a half years ago. They would also see clear signs that OS/2 is on the verge of acceptance— first among the leading-edge users and before long by a substantial number of ordinary users.

More and more decision makers are encouraging the shift to OS/2. What is still only a trickle will be a steady stream by spring, and by the end of next year OS/2 will be well on its way toward becoming the mainstream operating system for IBM-compatible PCs.

Despite what is said today by those whose foresight is as bad as their assumptions, the future lies with OS/2. And that future isn't as remote as it may seem. It's just around the bend. ∎

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Stephen
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After years of working with keyboards and screens, we still have no true standard for moving the cursor. The latest candidate employs two all-but-forgotten devices: your thumbs.

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No matter how much engineers transmute, permute, and pervert keyboards, the spacebar remains the sole constant. Function, cursor, and punctuation keys waltz all over the board and acquire new siblings. The Enter and Backspace keys grow and shrink like Alice in Wonderland. International conventions and speed-typing proselytizers waving the Dvorak banner make even the alphabet meander.

But though the good old spacebar may vary a mite in height and girth, it always ends up right where you want it, your willing slave, under your thumb. We take the spacebar so much for granted that nobody even bothers to label it. Space, as Sun Ra says, is the place.

The spacebar's endurance is quite a tribute to whoever—my references are mute on this point—came up with it. The typewriter was patented in 1868 and first marketed in 1874. The first citation for the term *space key* in the Oxford English Dictionary is from 1875: the sentence fragment "By holding the space key [of a type-writer] down while an 'I' and 'S' are struck"—to produce, I suspect, the mark of the Yankee dollar.

1888 marked the first literary step up to the *bar*: "In front of the four banks of keys there is a narrow strip of wood which is called the 'space-bar.'" From this we can draw two conclusions: first, a dozen years were all it took for the spacebar to become commonplace, and second, savvy merchandisers missed their opportunity to license "Spacebar Centennial" souvenirs.

The typewriter spacebar—we must remind those striplings who stare at typewriters and wonder where the Escape key is—simply moved the carriage along one space, thereby serving the function not only of spacing but also of a

computer keyboard's Right Arrow key. The backspace key, necessarily "nondestructive," was the old-fashioned equivalent of the Left Arrow; not until the invention of the correcting Selectric could a single key both backspace and munch. To this day, users who switch from typewriters to word processors must wean themselves from the habit of navigating the screen by spacing and backspacing.

A QUIVER OF ARROWS

Given the importance of cursor navigation, the pace of computer development, and the number of years that have passed since the introduction of terminals, one would surmise that cursor movement would by now have a spacebar of its own—a simple, intuitive, consistent, standardized interface. No such luck.

We're still dodging a quiver of arrows and a chain of supplementary keys that wander around from keyboard to keyboard, not to mention a plethora of "alternate input de-

vices," from the multibutton key-mouse to the preternaturally weird Felix pointing device. Even the once-mandatory Macintosh mouse is reportedly slated to be destabilized by the advent of a trackball on Apple's portable Mac.

Which brings us to the Isopoint key, newest entry in the cursor-movement sweepstakes. What seems to separate this device from all the rest is the same thing that made the spacebar what it is today: utter simplicity.

Stephen Manes

Just below the spacebar, for easy access by either thumb, sits the Isopoint key—a horizontal roller somewhat thinner than a drinking straw, exposed in a little cradle. Slide the roller left or right or thumb it up and down, and the cursor follows along. For a mouselike "click," push the roller down and let it go; hold the roller down while moving it for a classic "drag." Optional extra thumb switches on each side of the roller emulate mouse buttons two and three.

MIGRATORY RODENT

And that's it. The Isopoint key's use of the otherwise idle thumb seems ergonomically inspired. The key is always in the same handy place—unlike the migratory, drop-prone rodent that might better be termed a lemming. The Isopoint key leaves your hands in the main typing arena—unlike virtually every alternative, including most arrow keys. You can add the unit to an existing keyboard, but it makes more sense as an integral part of a keyboard's design—a particular plus for laptop machines in the dawn of the Graphical User Interface.

Drawbacks do spring to mind. Unlike a mouse or trackball, the Isopoint roller lacks "infinite" horizontal travel, relying instead on a spring-loaded switch to sense that you want to push the cursor beyond screen's edge. But even with mice, handling screen boundaries is really a problem of software rather than hardware.

The Isopoint key is probably not the device of choice for graphics; artists will probably miss the grand sweep of elbow and wrist. But for daily tasks—moving the cursor, picking menus, and the like—the device seems a real boon. Today, the hardware works with standard mouse drivers; someday, software conventions such as those used with today's arrow keys—say, Ctrl-Isopoint to speed things up, Alt-Isopoint to slow them down—could make the product even more useful.

Craig Culver, the Isopoint's inventor (Culver Research, 201 Ware Rd., Woodside, CA 94062), says he dreamed up the product when the Macintosh came out five years ago; it's since gone through roughly 50 iterations and three patents. He's been licensing it on a nonexclusive basis to various companies—the first licensee was Hewlett-Packard—but significant mechanical and electronic complications lurk behind the device's elegant facade.

At this writing, keyboard maker Alps Electric seems most committed to the product and poised to be the first manufacturer out with it. A manufacturer of mice and trackballs, Alps knows how to produce the complex optical encoders critical to the Isopoint key. At Spring Comdex, the firm showed prototypes of an add-on Isopoint key as well as machines with Isopoints built in. Result: machines with Alps-made Isopoints should hit the stores by the time these words see ink.

I don't want to overhype this thing; I've fooled around only with prototypes, and reactions among astute friends who've tried it vary from ecstasy to grunting. There is a long, dippy history of innovations that didn't quite make it, and this one could well end up just another footnote. But the Isopoint key seems different. With thumbs-up from users and a lot of luck, Culver might just earn the fame and fortune that apparently eluded the guy who invented the spacebar. ∎

In your wildest dreams, if you could do absolutely anything you wanted with your data files, what would you do?

You'd organize them, of course. Manage them, too.

From time to time you'd prob-

See DOS run.
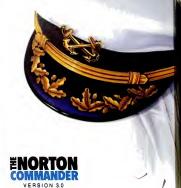
ably need to look for them.

But most of the time, you'd just want to look *at* them—or through them—instantly.

You might even want to send them electronically to someone else so they could examine them, too.

Or transfer them to your laptop so you could play with them at home. Or away from home.

Naturally, you'd want to be able to do all of these things without having to do much of anything yourself.

Maybe pull down a menu, hit a couple of keys or nudge your mouse every so often.

Seeing is relieving.

Well, stop dreaming. Because the new Norton Commander® has arrived and it's better than anything else you can use to deal deftly with DOS.

In fact, the new Norton Commander is so good, it's even better than the old Norton Commander.

Which is pretty remarkable, considering that *InfoWorld* called the original version "tops in its class…a new level of conven-

THE NORTON COMMANDER
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Dust of your modem. With just a couple of keystrokes, our new Commander Mail lets you instantly exchange files, faxes, telexes and E-Mail with any MCI Mail subscriber.

ience for MS/DOS users."

They called Version 2.0 "a near-perfect DOS shell…the market's best…recommended for all DOS users, regardless of expertise."

We can't wait to see what the critics will say about our latest version.

And neither should you.

Now you see it. Now you don't have to.

The new Norton Commander combines all the functions of a hard disk manager with all the features you need to support and enhance the DOS command line.

Two Aces and a King

The Big Three Word Processors Raise the Ante

by Edward Mendelson

IBM DisplayWrite 5/2, Microsoft Word 5.0, and WordPerfect 5.0 sit at the top of the word processing heap—and justifiably so. Which one's right for you? In order to decide, you'll need to review their individual strengths and weaknesses carefully.

Think twice about your choice of a word processor, because no other kind of software is so intimately connected to the way you think about everything else.

If you work at a computer, a word processor is the primary means by which you communicate your thoughts. A word processor is the medium with which you create everything, from a quick memo about the company picnic to a multivolume book that incorporates chapters written by a dozen coworkers and draws on charts, images, spreadsheets, and information culled from giant databases. Word processing software has matured to the point where the best programs let you produce documents at both ends of the spectrum—and everywhere in between—with an ease that was unimaginable a few years ago.

It isn't hard to create a program that can produce both a simple memo and an elaborately complicated book. The hard

part is adding all the features that make it possible for a dozen people on a network to produce a book over a period of months or years without making you work a week when you merely want to write and print a memo. The best of today's full-featured word processors are designed to let you do simple work in an uncomplicated and undemanding environment while keeping a complex maze of functions accessible—and easily navigable—for anyone who wants to explore them.

Almost two years ago, in the February 29, 1988, issue of *PC Magazine*, we tested 58 word processors. Since then, the market has remained remarkably stable, with few significant newcomers making a name for themselves and few major contenders dropping out of the competition. The major word processors are still character-based, although the market leaders now all include a noneditable graphics page preview and can import or even edit graphics to varying degrees.

Graphics-mode word processing, once essentially limited to the primitive functions of Microsoft's *Windows Write*, has begun to come into its own. At the low end of the scale, Samna's *Ami*, running under *Windows*, and, in far more ambitious ways, *IBM Interleaf Publisher* both make graphics-mode word processing a reality. *Ami Professional* and *Microsoft Word for Windows*—the unannounced product that must be the worst-kept secret in Microsoft's history—will occupy the middle ground when they become available.

Now, *PC Magazine* takes a long look at the latest versions of the three market leaders (in revenue): *WordPerfect 5.0* and *Microsoft Word 5.0*, which run under DOS or OS/2 and were Editor's Choices in 1988, and the OS/2-only *DisplayWrite 5/2 Composer*. We also take a brief look at the other programs that earned the Editor's Choice rating in 1988 (see the sidebar "Beyond the Big Guys"). *WordPerfect* holds a decisive lead in the market, with sales of 140,000 copies a month. Second-place *Microsoft Word* is campaigning aggressively to narrow the gap, and *DisplayWrite* maintains its market share through the loyalties of offices that will buy anything as long as the box has big blue letters reading "IBM."

All three programs belong in the cate-

gory of full-featured word processors, as contrasted with smaller "executive" word processors like Symantec's *Q&A Write* and Software Publishing's *Professional Write*, which are designed mostly for brief reports and mailing-list applications. Executive word processors have a wide audience, but the market as a whole has decided it prefers the power of full-featured programs, even if most users never need anything more than they can find in executive programs.

No full-featured program can hope to be taken seriously today unless it includes programmable merges and macros, remappable keyboards, sorting and math

> Word processing software has matured to the point where the best programs let you produce documents at both ends of the spectrum—from a quick memo to a multivolume book—with an ease that was unimaginable a few years ago.

functions, a speller and thesaurus, hyphenation, footnotes and endnotes, outlining, automatic cross-referencing, multilevel tables of contents and indexes, document summaries, snaking and side-by-side columns, and file-management functions within the program itself. *WordPerfect* and *Microsoft Word* contain all of these features, implemented to varying degrees; *DisplayWrite* has most of them.

PHOTO FINISH

A few years ago, speed was a reason to choose one word processor over another. Today, most full-featured programs race to a photo finish, and the difference between them hardly matters. In the PC Labs benchmark tests, *Microsoft Word* and *WordPerfect* performed almost identically at speeds approaching the championship speeds of *XyWrite* and *Nota Bene*. It no longer makes sense to let the benchmark

timings make your decision for you. Now the subtleties of style and functionality of a word processor matter infinitely more than its raw speed.

A full-featured word processor is like a language or a culture. In a few hours you can learn the few phrases needed to ask the way to the train station or reserve a hotel room. It takes longer to become fluent in the idioms and familiar with the local customs. You can't compare word processors the way the splashy ads do: by counting up a list of features and counting the keystrokes needed to perform a half-dozen functions. An advanced word processor is a complex environment that can't be understood by glancing at a few tourist attractions. The one that is best for you is the one you can imagine living in for years to come.

Word processing users often believe that the program they happen to prefer is the only one that conforms to the way human beings think—like the apocryphal Frenchman who said that the advantage of the French language is that the words come in the order in which you think them. Sometimes this belief turns into fanaticism. When you meet someone who tells you that *Microsoft Word* or *WordPerfect* is ideal and that *WordPerfect* (or *Microsoft Word*) is junk, you have met a word-processing fanatic. He probably is not dangerous, but if you value your safety, you will smile politely, agree with everything he says, and get out of the room as quickly as possible.

The idiom of most word processors (including *WordPerfect* and *DisplayWrite*) consists of codes that turn formatting on and off. When you want to change the left margin to 2 inches, you insert a left-margin code. Formatting codes are like gateways. On one side of the gate, one set of conditions apply; on the other side of the gate, another set applies. When you want to modify the format of a block of text, you insert a gate at the start of the block and another gate afterward.

Other programs (including *Microsoft Word*) tend to think in terms of areas of text to which formatting is applied like a coat of paint. If you want to change the left margin to 2 inches, you define the block that you want changed and tell the program to apply the new formatting. You won't find a format code at the start or end of the block, because all formatting information is stored invisibly at the end of the file as pointers to different areas of the text. Neither method is inherently superior, al-

For the features section of this issue, the associate editor was Donald P. Willmott and the PC Labs project leader was Pamela J. Milland.

though the gated method, for better or worse, lets you tinker more directly with the layout of your files.

HOW TO LOOK AT A PAGE

Other cultural differences include the ways in which programs think about pages. *Microsoft Word* joins *DisplayWrite* in defining the margins as the outline of the main body of text while pushing headers, footers, and page numbering into the blank area beyond the margin. *WordPerfect*, in contrast, treats the margins as the limits of the printed page, and takes away space from the body text when you add a header or footer. Again, neither method is superior. The first is preferable if you always want the main text to hold the same shape; the second is preferable if you want to know exactly what the limits of the printed page will be, and it tends to allow for more precise and predictable layouts.

Like a language or local customs, the interface of each of these programs bears vestiges of its archaic past. *WordPerfect*, *Microsoft Word*, and *DisplayWrite* would all look very different if their authors could redesign them from the start. All include illogical or nonstandard key assignments.

Neither *WordPerfect* nor *Microsoft Word* uses the otherwise standard F1 key to bring up a help menu. *DisplayWrite* uses F1 for help but doesn't conform to IBM's SAA interface. Don't try to persuade devotees of *Microsoft Word*'s alphabetical menus to like *WordPerfect*'s function keys, although the two interfaces are rapidly converging in style. *Microsoft Word* now makes extensive use of the function keys, while the forthcoming *WordPerfect 5.1* will include optional pull-down menus. *Microsoft Word* has always been designed for a mouse; *DisplayWrite* now has limited mouse support; and *WordPerfect 5.1* will make full use of the mouse.

You use a word processor to communicate. When choosing a program, consider how easy it is to communicate your program's files to other programs and different kinds of computers. You can buy third-party packages that convert word processor files from one format to another, but an advanced word processor should come with its own conversion facilities. *Microsoft Word*, *DisplayWrite*, and new *WordPerfect 5.1* can import comma-

delimited files from a database and part or all of a standard spreadsheet file without conversion. *Microsoft Word*, soon to be followed by *WordPerfect 5.1*, can link a document to a spreadsheet and update the document after the spreadsheet data changes. Full two-way hot links between documents and spreadsheets are still over the horizon but getting closer.

DESKTOP PUBLISHING

Word processors also need to communicate with the desktop publishing programs that import the word processor's files. If you choose a word processor whose files aren't understood by Aldus's *PageMaker* and Xerox's *Ventura Publisher*, you'll need to use tedious and inadequate conversion programs if you want to see your text appear in desktop-published glory. *PageMaker* and *Ventura* can directly import the major word processing formats, although it usually takes their vendors a few months to develop filters that handle all the new features in a new release of a word processing package.

For the first few months after *WordPerfect 5.0* appeared, *PageMaker* was unable to import its files except in *WordPerfect*

SUITABILITY TO TASK

PC Magazine assesses a word processing program's suitability in five arenas—Personal, Professional, Corporate, Legal, and Desktop Publishing—and assigns it a point value for each one. These subjective ratings, on a scale from 0 to 4, are presented along with each review and translate as follows:
0—lacks feature or is not at all suited;
1—poorly suited; 2—some capability;
3—well suited; 4—ideal for the task.

A **Personal** word processor should be very easy to learn and use. It is best suited for short documents, letters, and memos. Important features include context-sensitive help, simple menus, and clear documentation. Users include students, home users, executives, and other professionals who write short documents.

A **Professional** word processor is more full-featured. It should be able to handle long documents with extensive page formatting including complex headers, footers, and indexing. Printer control and dictionary support are both important, and likely users include professional and technical writers, academics, and those working in the publishing industry.

PRODUCT

Suitability To Task

Personal			
Professional			
Corporate			
Legal			
Desktop Publishing			

Corporate word processors should easily handle short documents, letters, and repetitive memos that are produced often, and should offer mail-merge. Document summaries (including author, revisor, and keywords) and envelope

printing are musts. Parallel versions running on IBM and DEC mainframes and minis or Unix systems are a plus. Note that not all users within corporations are corporate users.

Legal refers to the program's ability to handle the special functions required by lawyers and law offices, including line numbering, redlining and revision marking, compilation of tables of authorities, file comparison, and password protection.

Word processors with **Desktop Publishing** features must be able to handle multiple columns of text and to import common graphics files (.PCX, .CGM, TIFF) as well as *1-2-3* and *Excel* spreadsheet data. They should also be capable front ends and partners for *PageMaker* and *Ventura Publisher*.

To receive a rating of 4, the product should contain all the features users expect now (based on competitive products) or will find on similar products in the near future (a DTP rating of 4 indicates a superior word processor, not a word processor equal to *PageMaker* or *Ventura Publisher*).

4.2 format, which made *Word* a better choice if you were using it to send files into DTP. Then Aldus issued a spiffy *WordPerfect 5.0* filter, and the two packages were equal. Now *Word 5.0* has appeared, and *PageMaker* won't be able to import its new features until Aldus prepares a new filter. If you choose one program over another merely because your desktop publishing program has a more up-to-date filter for it, you may find the situation reversed in a few months.

Today's word processors need to communicate effectively on a network. All three of these programs can include nonprinting comments by different members of a workgroup. All support revision tracking using redlining and strikeout; *WordPerfect* has a built-in document-comparison function. *WordPerfect* and *Microsoft Word* let you create and print "frame" documents that include part or all of other documents created separately.

The best word processors let you recover easily from false moves. *Microsoft Word* has a flexible Undo command. *WordPerfect* lets you restore three deletions. OS/2 word processors will be even more forgiving: DeScribe Inc.'s *DeScribe* lets you play back an entire session to find any text you want to recover.

Word processors must evolve in order to survive. Five years ago, *WordStar* and *MultiMate* led the market. *WordStar* had the advantage of speed and its familiarity as a holdover from the CP/M era. *MultiMate* was the best of the programs that emulated the Wang dedicated word processors that took over the nation's offices in the 1970s. At the end of the 1980s, word processors based on CP/M and Wang models seem as awkward as beached whales. Recent versions of *WordStar* and *MultiMate* have belatedly added features in an attempt to stage a comeback, but few users show any interest in switching to these programs from any others.

Today's most successful word processors, *WordPerfect* and *Microsoft Word*, were first conceived almost 10 years ago. Will new versions of these programs continue to dominate the DOS and OS/2 market in the 1990s, when graphic user interfaces begin to supplant the character-based screens of the 1980s? Someone somewhere has begun to imagine the word processor best adapted to the new operating systems and platforms of the next decade. WordPerfect Corp., Microsoft, and IBM all hope that that person is working for them right now.

DisplayWrite 5/2 Composer

The bulky package of IBM's $695 *DisplayWrite 5/2 Composer* contains two completely separate OS/2 applications: *DisplayWrite 5/2* itself and the new *Composer Extension*. The first of these—let's simply call it *5/2*—is a character-mode word processor that evolved from IBM's standalone Displaywriters of a couple of decades ago and the DOS versions of *DisplayWrite*. *5/2* is a dinosaur, but an advanced dinosaur, and the latest version has features that looked impressive when rival

DISPLAYWRITE
5/2 COMPOSER

Suitability
To Task

Personal	
Professional	
Corporate	
Legal	
Desktop Publishing*	

*With the addition of the Composer Extension module.

packages added them in 1985. It even has some new features that look impressive today. *Composer*, in contrast, is an up-to-date, bright-looking, graphics-mode, quasi-desktop publishing program. It can read *5/2* files and has a keyboard interface that resembles that of *5/2*, but the resemblance stops there.

The difference isn't limited to such odd contrasts as the presence of mouse support in the text-mode *5/2* and its complete absence in the graphics-mode *Composer*, where you have to use the arrow keys to push the cursor because the mouse driver wasn't ready on time. The difference is one of culture. *5/2* is a pure IBM product, while *Composer* is the work of a company called Beyond Words. If *Composer* looks familiar to you on-screen, that may be because you've seen pictures of another pro-

gram built around the same engine, IMSI's *PagePerfect*, an underwhelming DTP package introduced last year.

The story of the two programs in *DisplayWrite 5/2 Composer* is a human interest story as much as a software story. It's the story of the users who struggle with the two programs, the support technicians who are bewildered by them, and the programmers who fight internecine battles within IBM over the issues of interface and design.

Above all, *DisplayWrite 5/2 Composer* is the story of its users. They typically work in offices where no one ever got fired for buying IBM. *5/2* does have advanced and clever features, like columns automatically balanced in length so that the last column on a page isn't shorter than the others, and mail-merge with variables. But *5/2* is so tied to its past that its speller still contains the name of the old standalone Displaywriter but not the name of the *DisplayWrite* program itself.

TYPEWRITER METAPHOR

The old Typewriter was designed around a typewriter metaphor, and the latest version hasn't forgotten this. You still can't see the bottom of one page and top of the next on the same screen, and the left and right arrow keys won't even take you back to the previous line or forward to the next. (The right arrow takes you into the right margin and beyond, although you return to the page as soon as you start typing.)

If you add text to existing pages, you have to choose Repagination from a menu and wait while *5/2* calculates the new page breaks. By entering some carriage returns at the bottom of a page, I got *5/2* so confused that even after repaginating, it told me the cursor was at line 137 on page 2, and then locked up the computer when I tried to repaginate a second time in order to sort out the problem.

Despite OS/2's multitasking, *5/2* won't let you print the document on-screen. If you forget to repaginate before printing, *5/2* sometimes spews out blank pages at the end of the print job, apparently endlessly. If you stop it by turning off the computer, *5/2* will tell you that the file is "in use" when you try to edit it later. You have to use *5/2*'s Recover command and then delete a couple of backup files before you can do anything with the file again. *DisplayWrite* is the only major application that includes a command to Recover files that it mangled all by itself.

DURING ONE LUNCH HOUR 30 NOVICE DOS USERS LEARNED TO DO ALL THIS.

- Move five directories from one place to another.
- Format two floppy disks.
- Copy a floppy into a newly created directory!
- Determine the free space on a disk.
- Determine the size of all directories.
- Delete three entire directories.
- Start programs with a single key-stroke.
- Create a volume label on a floppy.
- Change the date and time on the computer.

(OVER)

5/2 supports many non-IBM dot matrix and laser printers but doesn't understand them very well. Until you change the defaults, it thinks your laser printer uses fanfold paper.

Although both *5/2* and *Composer* require OS/2, Version 1.1, neither uses Presentation Manager, neither runs in a text window, and neither conforms to the SAA standard. Sources within IBM explain that *5/2*'s keyboard was modified to match the tentative SAA standard that IBM planned some years ago—until the SAA designers changed the rules, a change that caused much consternation among the *Display-Write* designers.

When *5/2* appears on-screen, you see a menu asking if you want to create, revise, or print a file. After making your choice, you reach a screen whose top two lines are a status display that tell you whether you are creating or revising a file, the name of the file, the cursor position, and other format information. Below this is a one-line menu of six function keys, and then a ruler line. The menu is highly selective. It gives you access to basic editing functions only, and you'll need to memorize which ones are listed under "F5=Instructions" and which are under "F7=Instructions."

You can safely guess that some advanced functions are on the Control state of the keys listed on the menu, but you'll need a keyboard chart and a help menu to find most keys. Some of the keyboard assignments seem chaotic. F1 is the Help key, but Alt-5 brings up a list of key assignments. Alt-8 deletes to the end of the line, but Alt-7 does nothing. If you want to indent a paragraph, don't try Ctrl-I, which also does nothing; use Ctrl-T instead. Is Print on Ctrl-F12 or Alt-4? Actually, it's on both. Is cursor line drawing on F11 or Alt-1? It, too, is on both. You can press Ctrl-A to open a *xyWrite*-like command line that can save you a lot of menu-hopping, although some functions are available only via the menus.

WINNING FEATURES

Among the better features of *5/2* are split-screen editing, hidden text, a notepad for storing blocks of text, tables of contents and indexes, centering on any point on a line, and a flexible footnote function that allows you to gather a group of notes on a single page or store notes in a footnote library to reuse in different files. Even the best of the features is clumsily implemented. For example, the new graphics page preview, which has multiple zoom levels,

DisplayWrite 5/2 Composer offers several pictures (in a proprietary format) for insertion into documents. They are explained in the upper-left-hand corner of the screen and are previewed along the right.

Fifty style sheets, all of which can be modified, are included in the DisplayWrite 5/2 Composer package. This four-column layout includes a picture loaded from the picture library.

Features new to the basic DisplayWrite 5/2 package are Zoom and Preview. In the full-page preview zoom, text is illegible but the view accurately depicts what the layout of the paper page will look like.

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often gets confused at the top zoom level and displays the same text simultaneously in two sizes, one overlapping the other.

If your printer supports them, *5/2* lets you print and display about 400 characters above the standard ASCII set by choosing one of four supplied extended character sets and then typing an Alt-letter combination from a chart in the manual. Only a fraction of the 400 characters are included in the four default character sets, and you can edit one of four duplicate sets if you want to use any of the other characters.

Choosing a typeface is even more complicated. *5/2*'s font menu makes you choose a font by number. If you want to choose a font that comes in a variety of different heights, like the Helvetica available with many laser printers, all *5/2* tells you is to make your choice among fonts numbered from 4,096 to 61,439. Can't remember that Helvetica Italic is font number 34,231? IBM explains that it's easy to find out: just use OS/2's multitasking functions to open another *DisplayWrite* session and print the text file that lists the fonts available in your printer. Every other advanced word processor lets you choose fonts by name from a menu.

The manual says you can include graphics in *5/2* but omits the awkward fact that you can't actually insert them via *5/2* unless they've already been converted into IBM's RFT format. You can, however, bring in .WK1 and .DBF files with reasonable ease.

COMPOSER EXTENSION

When you turn to the *Composer Extension*, you're in another world. The function keys are similar to those in *5/2*, but the

WORD PROCESSORS: SUMMARY OF FEATURES

(Products listed in ascending price order)

	Microsoft Word 5.0 $450	WordPerfect 5.0 $495	DisplayWrite 5/2 Composer $695
TEXT FORMATTING FEATURES			
Both 10 and 12 cpi available	■	■	■
Proportional spacing	■	■	■
Adjustable letter spacing	□	■	■
Adjustable left and right margins	■	■	■
Fractional line spacing	■	■	■
Spacing adjusts to font height	■	■	■
Double underline	■	■	■
Superscripts/subscripts	■	■	■
Insert mode and replace mode	■	■	■
Strikethrough	■	■	■
Small capitals	■	■	■
Nonprinting comments	■	■	■
Adjustable top and bottom margins	■	■	■
Maximum page length (inches)	22	18	45.5
Variable page length within document	■	■	■
Vertical centering	■	■	■
Tabs can be entered anywhere	■	■	■
Tabs move when left margin changes	■	□	■
Conditional page breaks	■	■	□
Paragraphs can be linked (together on one page)	■	■	□
Unbreakable blocks	■	■	■
Widow/orphan control	■	■	■
Automatic page numbering	■	■	■
Automatic resetting of page numbers	■	■	■
COMMAND STRATEGY			
Command line	□	■	□
Full-screen menus	■	■	■
Lotus-style menus	■	□	■
Menus can be bypassed from keyboard	■	■	□
Permanent defaults can be changed	■	■	■
Temporary defaults can be set	■	■	■
SCREEN DISPLAYS			
Screen displays ruler line	■	■	■
Ruler line can be suppressed	■	■	■
Margin positions are graphically displayed	■	■	■
Page breaks are shown while typing	■	■	■
Paragraph markers can be displayed continuously	■	■	■
Format codes can be displayed	■	■	■
TEXT ENTRY AND EDITING			
Undelete capability	■	■	■
Multiple undelete levels	□	■ (3)	□

□ = Editor's Choice   ■ = Yes   □ = No

	PC Microsoft Word 5.0 $450	PC WordPerfect 5.0 $495	PC DisplayWrite 5/2 Composer $695
Mouse-controllable cursor	■	□	□
Word block	■	□	■
Line block	■	□	■
Sentence block	■	□	■
Paragraph block	■	□	■
Column block	□	□	■
Page block	■	□	□
Block can be extended	■	□	■
Reformats automatically after block move	■	□	■
Copies or moves to another window	■	□	■
Saves reformat parameters to a file	■	□	
Appends block to an existing file	□	□	■
Search-and-replace			
Works forward and backward	■	■	■
Verifies replace	■	■	■
Searches within other files	□	□	■
Performs case-sensitive search	■	□	■
Preserves case when replacing	□	□	□
Can recognize string as a complete word	■	■	■
Uses wildcards	■	■	□
Search-and-replace for format codes or settings	□	■	■
Search-and-replace for text attributes (underline, italic, bold)	■	■	□
Text windows			
Number of windows	8	2	2
Split-screen windows	■	■	■
Full-screen windows	■	■	■
PRINTING			
Number of printers supported	275	450	60
PostScript printers supported	■	■	■
Queues documents for printing	■	□	■
Can change print queue	■	□	
Prints block	□	■	□
Prints continuous range of pages	■	■	■
Prints discontinuous range of pages	■	■	□
Prints current page (without requiring page number)	□	■	□
Automatic envelope formatting and printing	■	■	□
Landscape mode	■	■	■
FILE HANDLING			
Maximum file size	8.3MB	Unlimited	2.4MB
Creates .BAK file	■	■	■
Makes backup during save and resume	■	□	■

CONTINUES

WYSIWYG screen with graphics and bit-mapped fonts in multiple sizes and styles tells you that you've moved from the Kansas of word processing into the Oz of desktop publishing. It's a nice place to visit, but you wouldn't want to live there.

It's nice to visit because you can get kerning, leading, dropped or enlarged capitals, hyphenation control, and other DTP wonders. Unlike in DOS DTP programs, you can split the screen between two documents. But you won't want to live there for dozens of reasons. First of all, the transportation is primitive. Instead of using a mouse, you have to use the Ctrl-Arrow keys to move the cursor long distances, the Shift-Arrow keys for small distances, and the unshifted Arrow keys for distances in between. If you press an Alt-Arrow key, the program will merely beep at you—something it does all too often.

You can import graphics files as long as you choose one of the sample files included with the program, a TIFF file, a Lotus .PIC file, or one of IBM's own graphics formats. *Composer* also directly supports IBM scanners. If you have any .PCX files, you'll have to leave them at the door. You can flow text around rectangular graphics but not around irregular graphics.

Composer's Styles menu shows you exactly what your text will look like, down to the jagged-looking fonts you see on-screen. With any non-PostScript printer, including the HP LaserJet, *Composer* doesn't use the fonts that come with the printer, but only its own graphics fonts licensed from AGFA Compugraphic. *Composer's* versions of these fonts are coarse and can make a laser printer look like a dot matrix. Even though the fonts are graphic, you can't scale them at print time. If you don't want to use the fonts generated at installation, you have to load a Font Librarian program that generates new screen and printer fonts and then use those. The package comes with versions of Times, Helvetica, and Courier.

Composer will use the Times, Helvetica, and Courier fonts in PostScript printers, but only in sizes that match *Composer's* screen fonts. You can't use any of the other fonts that come with almost all PostScript printers today. Don't get the idea that you can use *Composer* to proof PostScript files that you later send out to a service bureau. Incredibly, *Composer* doesn't let you print to disk.

To help you find your way around these two programs IBM now offers toll-free tech support, though we found its useful-

ness spotty at best. One technician read passages from the *5/2* manual in answer to a question about *Composer* and then gave me answers that were simply wrong. *DisplayWrite*'s two-volume looseleaf manuals are written in IBMese, a language in which elementary concepts are explained in vast detail while complex ones are left sketchy and incomprehensible.

If you work in an all-IBM office that uses OS/2, you're going to use *DisplayWrite 5/2 Composer*, and you can accomplish a lot with it if you're patient enough to navigate its menus and generous enough to ignore its quirks. But if you want convenience and ease from your word processor, move to an office that uses *WordPerfect* or *Microsoft Word*.

Microsoft Word 5.0

Microsoft Word is Microsoft's $450 quick-change artist. If you don't like the way it looks when you install it, you can make it look like a completely different program. Do you want to remove the double-bordered frame that surrounds the text window? Do you want to display a ruler line? Or remove the two-line menu, with its alphabetical list of commands? Or display nonprinting characters like paragraph marks and tabs? Or assign screen colors to any style of text or any element of the display? Or, with a graphics adapter, display italics and superscripts, or put 35, 43, or 60 lines on-screen? Or display text with true line-breaks that scroll off the right edge of the screen, instead of breaking the

MICROSOFT WORD 5.0

Suitability To Task

Personal	▣▣▣▣▣
Professional	▣▣▣▣
Corporate	▣▣▣▣
Legal	▣▣▣▣
Desktop Publishing	▣▣▣

WORD PROCESSORS: SUMMARY OF FEATURES

(Products listed in ascending price order)

	Microsoft Word 5.0 $450	WordPerfect $495	DisplayWrite 5/2 Composer $695
Performs backup at timed intervals	■	■	■
Temporarily goes to OS/2	■	■	■
Includes file management functions	■	■	■
Can search disk for a filename	□	■	■
File import/export			
DCA	■/■	■/□	□/□
Microsoft Word	■/■	■/□	□/□
MultiMate	□/□	■/■	□/□
WordPerfect	□/□	■/■	□/□
WordStar	□/□	■/■	□/□
Lotus 1-2-3	■/□	■/□	■/□
SPELLING CHECKER AND HYPHENATION			
Spelling checker	■	■	■
Number of words in dictionary	130,000	130,000	100,000
Maximum number of user dictionaries	1	1	3
Spell-checks defined block	■	■	□
Legal spelling checker	■	□	□
Medical spelling checker	■	□	□
Hyphenation			
Based on algorithm or dictionary	Algorithm	Both	Dictionary
Inserts soft hyphens	■	■	■
Allows entering soft hyphens from keyboard	■	■	■
Readjusts to additions and deletions	■	■	■
MANUSCRIPT PREPARATION			
Footnotes and endnotes	■	■	■
Different fonts	■	■	■
Automatic numbering	■	■	■
Multilevel table of contents	■	■	■
Multilevel indexing capability	■	■	■
Cross-referencing	■	■	□
DESKTOP PUBLISHING FEATURES			
Snaking columns	■	■	■
Single and snaking columns on same page	■	■	■
Maximum number of columns	22	24	12
Full justification and microjustification	■	■	■
Side-by-side columns	■	■	■
Maximum number of columns	Unlimited	24	12
Unmatched column widths available	■	■	■
Column widths defined by moving cursor	□	□	■

□=Editor's Choice ■=Yes □=No

	Microsoft Word 5.0 $450	WordPerfect 5.0 $495	DisplayWrite 5/2 Composer $695
Adjustable gutter widths	■	■	
Single column automatically restored	■	■	□
Line drawing using cursor	■	■	■
Line drawing using menu	■	■	■
Expandable box around text	■		
Graphics files imported	.EPS,.HPGL, .PCX, .PIC, .TIF	.CGM, Dr. Halo, .DXF, .EPS, .HPGL, .IMG, MacPaint, .MSP, .PCX, .PCX, .PIC	.GOCA, IOCA, .PIC, .TIF
Text flowing around graphics	■	■	□
Page preview	■	■	■
Full-page portrait monitor supported	■	■	□
Zoom image	■	■	□
Imports directly from PageMaker	□	■	□
Imports directly from Ventura Publisher	□	■	□
Exports directly to PageMaker	■	■	□
Exports directly to Ventura Publisher	■	■	■
NUMERIC FEATURES			
Arithmetic operations within document	■	■	■
Keyboard calculations	■	■	□
Pop-up calculator	□	■	□
MACROS			
Number of macros	Unlimited	Unlimited	Unlimited
Programmable macros (using "if/then")	■	■	■
HELP, DOCUMENTATION, AND ERROR HANDLING			
Context-sensitive on-line help	■	□	■
Adjustable help levels	□	□	□
Documentation			
Keyboard templates	■	■	□
Tutorial	■	■	■
Indexed reference manual	■	■	■
Error messages			
Explain error	■	■	■
Explain remedy	□	■	■
Alert user when abandoning, aborting, or quitting an altered file	■	■	■
TECHNICAL SUPPORT			
Free support	■	■	■
Toll-free telephone number	□	■	□

ENDS

lines for convenience at the edge of the screen? Or display the coded abbreviations of paragraph formats to the left of the paragraphs themselves? Or collapse or expand a document created using *Word's* built-in outliner? You can do all this and more with a few keystrokes or mouse twitches.

Microsoft Word is just as adept at making quick changes in text as it is in changing the screen. Any word processing program can transform the format of a page by using stylesheets of the kind pioneered by *Word* itself in 1983. But *Word* makes it easy to transform *anything* on a page, even if you didn't bother to set up a stylesheet first. A format search-and-replace function lets you change any text from 12-point bold-underline Courier to 10-point italic Times Roman in seconds. A single command lets you alter any paragraph with a one-inch first line indentation to a half-inch indentation without searching for each paragraph in the file.

You can decide at any time whether or not to print or display "hidden" text, and you can change your mind again afterward. With stylesheets, you can apply highly elaborate formatting to a paragraph simply by putting the cursor anywhere in the paragraph and typing the Alt key and one or two letter keys. Even without stylesheets, you only need to press an Alt-letter key to apply common formats.

Besides making quick changes, *Word* also saves and prints quickly and lets you move quickly around a file. It can now paginate on the fly, and when you jump from the top to the bottom of a file, automatic pagination doesn't slow you down. *Word* paginates in the background, so a page break will sometimes appear on-screen after the text in which it occurs. Unfortunately, *Word* is too quick to abandon deleted text: it has only one-level undeletes, compared with *WordPerfect's* three and *Nota Bene's* five. But *Word* now has automatic timed backup, so you can recover text deleted 20 minutes ago.

MAKING TEXT LOOK GOOD

No word processor approaches the ease with which *Word* lets you format text, both directly through formatting commands and automatically through stylesheets. Some of *Word's* formatting functions can be duplicated in other programs only through tedious and unreliable macro programming. For example, if you format a paragraph to be preceded by a one-line space, *Word* knows enough to omit the extra space when the paragraph comes at the top of the

At last! A new HP LaserJet just for you.

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The HP LaserJet printer family has expanded— in a small way.

The new HP LaserJet IIP (as in Personal) fits right on your desk. And, with a price almost half of the multi-user LaserJet Series II, into most budgets.

Its simple front panel gives you easy, push-button control over the menu, the 14 internal fonts, form feed and other functions. It handles four different paper sizes: letter, legal, executive and A4, as well as envelopes. In portrait

*Suggested U.S. list prices:
LaserJet IIP $1495;
LaserJet Series II $2695.
Dealer prices vary.

Microsoft Word's style sheets are displayed and edited in a screen accessed from the Gallery menu. Formatting for any paragraph can be described in comprehensible English.

Microsoft Word can display different parts of the same document in up to eight windows at once. The letters next to the paragraphs represent style codes.

Microsoft Word's page-preview screen presents almost-readable text, but the image can't be enlarged to reveal fine detail.

page. Word can automatically keep a heading and text together by forcing the last lines of one paragraph to print on the same page as the first lines of the other.

You can put boxes around text simply by moving the cursor into a paragraph or highlighting a block and pressing a few keys. You can position a paragraph on a page and make other text flow around it, although Word sometimes gets confused by the resulting narrow columns and prints two paragraphs on top of each other.

When Word's original authors rethought the whole concept of formatting text for a printer, they got it almost entirely right. They divided formatting into character formats (type styles, text attributes like italic), paragraph formats (indents, linespacing, space before and after), and "division" formats (margins and columns). There's nothing wrong with the concept of divisions, except that Word takes them too seriously. A single chapter or report can have multiple divisions, but Word insists on assigning the number 1 to the first footnote in each and forces you to renumber the notes in any later division by hand.

For all its skill at basic formatting, Word doesn't equal the subtlety and precision with which WordPerfect controls a printer. Word doesn't let you adjust letterspacing and word spacing anywhere in a document, doesn't support kerning, and offers a limited number of widths for borders and lines. Word comes with printer drivers that sometimes include more fonts and cartridges than the printer can hold at any one time; if you don't use a utility program to modify the drivers, Word's font menu often lets you choose fonts that you don't actually have, with disastrous results on the printed page. Word supports more than 275 printers, roughly half the coverage of WordPerfect.

To print a nonstandard foreign or technical character, you have to figure out for yourself whether your fonts support it and then remember which ASCII character you should type to the screen in order to get the completely different character that you want at the printer.

BRINGING IN GRAPHICS
Word imports most standard graphics formats and lets you resize images and position them in relation either to the text or to a specific location on the page. Text can flow around rectangular but not irregular graphics. A screen-capture utility lets you rotate images 90 degrees. Graphics themselves are not included in a Word file, only

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PERFORMANCE TESTS: THREE MAJOR WORD PROCESSORS

All three of these popular, high-end word processors perform well on our tests. The speed differences are slight except in isolated cases. Clearly, when you want to decide among these competitors, feature sets are a far more important consideration than relative speed.

For this set of performance tests, PC Labs tested under both OS/2 and DOS. *DisplayWrite* is represented by its highest DOS version (Version 4.2) and its OS/2 version (5/2). Our test equipment was an IBM PS/2 Model 70-A21 running at 25 MHz with a 120MB hard disk and 4MB RAM. A Hewlett-Packard LaserJet Series II was used for printing. A 50,000-byte ASCII file was used for testing, and all timing was done with a stopwatch.

Program Load | Elapsed Time (seconds)
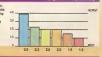
The **Program Load** test times how long it takes to load the word processing program from the hard disk, from the moment the Enter key is pressed at the command line (with no parameters active) to the moment that keystrokes can be entered in the program.

3.2 2.5 3.0 3.1 1.2 1.8

Import File | Elapsed Time (seconds)

The **Import File** test measures the time required to bring in the test file from the hard disk and have the word processing software convert it to the package's native format. Timing starts when the key is pressed to begin the import and ends when the file is on the screen.

7.2 5.5 1.0 1.0 1.8 1.8

Save and Continue Edit | Elapsed Time (seconds)
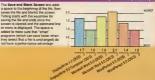
In the **Save and Continue Edit** test, the file is saved to the hard disk while it is being edited. Timing starts at the moment the command to save is executed and ends when keyboard control is regained.

3.9 2.3 2.0 2.0 1.5 1.0

Save and Blank Screen | Elapsed Time (seconds)

The **Save and Blank Screen** test adds a space to the beginning of the file, then saves the file and blanks the screen. Timing starts with the keystroke for saving the file and ends once the screen is cleared and the command line or menu is displayed. The space is added to make sure that "smart" programs (which can save faster when they detect that a file is unchanged) do not have a performance advantage

1.7 1.0 1.8 2.1 1.4 1.0

DisplayWrite 4.2 (DOS)
DisplayWrite 5/2 Compose (OS/2)
Microsoft Word 5.5 (DOS)
Microsoft Word 5.0 (OS/2)
WordPerfect 5.1 (DOS)
WordPerfect 5.0 (OS/2)

CONTINUES

300 fonts
in the palm of your hand.

It's amazing. You would have to buy dozens of cartridges for your HP LaserJet printer to get the fonts that SuperSet delivers in two.

With SuperSet you get 300 fonts. And SuperSet is the only multi-font cartridge set that includes JetFont's exclusive 12/20 spreadsheet fonts for printing up to 40,000 characters per standard page. Best of all, SuperSet's two cartridges utilize the LaserJet's dual slots to work simultaneously, giving you all the fonts you need without ever changing cartridges.

Others claim to put over 150 fonts on a single cartridge, but their shortcuts can boggle your software drivers and leave you unable to perform simple operations. SuperSet drivers allow you to interface more easily with WordPerfect, PageMaker, MicroSoft Word, and Windows, Wordstar 2000, Lotus 1-2-3, dBase III, Display-Write, MultiMate Advantage II, Ventura Publisher and other popular programs.

Crisp, clean, HP-equivalent font families from Tms Rmn to Helv, presentation graphics to bar codes. Backed by JetWare's reputation for quality and consistency. After all, we're the only company that offers the complete family of HP font cartridges and soft fonts from A to Z. Plus a five-year warranty.

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an instruction to include the graphic at print time. TIFF files are noticeably degraded in printing, even at *Word*'s highest resolution. *Word* now offers a graphic page preview, but it displays only a miniature image with barely readable text and can't zoom in for a more detailed view.
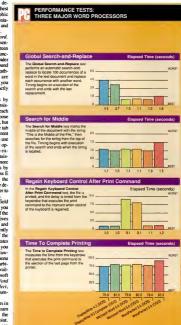
It isn't hard to learn the basics of *Word*. The paperback manuals are clear and sensibly arranged by topic. The on-screen menu gives quick access to essential functions, and anything you don't find under the obvious places is likely to be found among the miscellaneous functions gathered under Library. Tutorial files are linked to context-sensitive help, so you can get a quick, focused lesson exactly when you need it.

Word's menus, which you reach by pressing the Esc key, are mildly inconsistent in design. In the higher levels of each branch in the menu tree, you can choose options quickly by pressing letter keys, but at the lowest level you have to use the tab or arrow keys to move around the different fields in the menu—and then you can use letter keys again to choose among the options in each field. If you use a mouse exclusively, you won't notice the inconsistency, but you'll get your work done more slowly. You can exit most submenus by pressing Esc, but some make you press E for Exit. To rename a file you use the Transfer Rename menu, but to copy or delete the same file, you need to jump over to the Library Document-Retrieval menu.

Whenever you can fill in a menu field with an item from a list, *Word* lets you press F1 to see the available choices. If the choices are a list of files, the screen gives you convenient access to other drives and directories, although *Word* inconveniently refuses to display the date or size of the files listed. *Word*'s keyboard uses all states of the function keys. Some keys give you access to functions like cursor line-drawing, which you can't reach from the menu at all. Other keys are shortcuts to an arbitrary selection of options normally available from the menu; in this respect, Microsoft uses these shortcuts to claim that *Word* needs fewer keystrokes than WordPerfect, but the shortcuts cover only a small number of *Word*'s many options.

With a mouse you can scroll bars in the border of the text window to roam around a document without moving the cursor that represents the text-entry point. Using either the mouse or a menu, you can split the screen into up to eight windows, including a footnote window that automat-

PERFORMANCE TESTS: THREE MAJOR WORD PROCESSORS

Global Search-and-Replace

The Global Search-and-Replace test performs an automatic search-and-replace to locate 100 occurrences of a word in the test document and replace each occurrence with another word. Timing begins on execution of the search and ends with the last replacement.

Elapsed Time (seconds)

WORST	
BEST	

4.5 3.7 1.0 1.6

Search for Middle

The Search for Middle test marks the middle of the document with the string "This is the Middle of the File," then searches for the string from the top of the file. Timing begins on execution of the search and ends when the string is located.

Elapsed Time (seconds)

WORST	
BEST	

1.1 1.1 1.1 1.5

Regain Keyboard Control After Print Command

In the Regain Keyboard Control After Print Command test, the file is printed, and the delay is timed from the keystroke that executes the print command to the moment when control of the keyboard is regained.

Elapsed Time (seconds)

WORST	
BEST	

1.0 9.1 8.1 1.1 1.2

Time To Complete Printing

The Time to Complete Printing test measures the time from the keystroke that executes the print command to the ejection of the last page from the printer.

Elapsed Time (seconds)

WORST	
BEST	

76.5 81.3 79.9 82.0 78.4 93.3

DisplayWrite 4.2 (DOS)
DisplayWrite 5.0 Compater (OS/2)
Microsoft Word 5.0 (DOS)
Microsoft Word 5.0 (OS/2)
WordPerfect 5.0 (DOS)
WordPerfect 5.0 (OS/2)

CONTINUES

ically displays the notes linked to the text that appears in another window.

STYLESHEETS

The one steep cliff in the learning curve is the point where you start to learn stylesheets. Word makes the climb easier by letting you first apply format to text and get an idea of how the new format looks, and only then record the formatting to a stylesheet—although you can still save steps by typing formatting commands directly into a stylesheet.

Most Word users probably never touch stylesheets and manage very well without them. But if you use proportional type or any moderately fancy layouts, you will only waste time by not modifying at least the default stylesheet. Unless you modify the stylesheet, Word defaults to typewriter-style six lines per inch, and you'll have to change the line spacing by hand to the "Auto" setting. WordPerfect, in contrast, automatically adjusts line spacing to match any font you choose.

Unlike most other word processors, Word's mail-merge and macro functions use virtually the same straightforward programming language. Programmed macros, keystroke-recorded macros, and boilerplate text are all stored in Word's
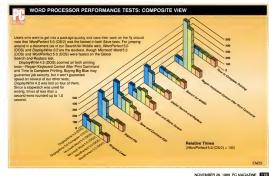
"glossary" files—either in the default glossary or the glossaries for special uses—and boilerplate text can be associated with styles. Macros can be invoked from key combinations and can run DOS commands. The powerful merge functions let you vary the text included in a document depending on whether certain fields

have numbers greater or lesser than numbers you specify or contain place-names or any other text.

Word's speller is now integrated into the rest of the program and can flag minor errors in capitalization and punctuation. Although, as with any speller, you can add words to a user dictionary, Word can't display added words among its suggested alternatives when it finds a misspelling. Word incorporates the industry-standard WordFinder thesaurus. The hyphenation function uses an algorithm and can't be supplemented by a dictionary as in WordPerfect.

Word's document retrieval feature lets you locate files by searching for text in summary screens or the files themselves. You can link Word documents to spreadsheets of up to 32K, but you must give an explicit command to update the link after altering data in the worksheet. You can also link a document to part or all of other Word documents in the same way.

Within a single document, you can create automatic cross-references as well as an index and a table of contents. Both cross-references and links between documents economically make use of Word's new bookmark feature, which lets you jump to a named region of any file without

WORD PROCESSOR PERFORMANCE TESTS: COMPOSITE VIEW

Users who want to get into a package quickly and save their work on the fly should note that WordPerfect 5.0 (OS/2) was the fastest in both Save tests. For jumping around in a document (as in our Search for Middle test), WordPerfect 5.0 (DOS) and DisplayWrite 5.0 are the quickest, though Microsoft Word 5.0 (DOS) and WordPerfect 5.0 (DOS) were fastest on the Global Search-and-Replace test.

DisplayWrite 4.2 (DOS) zoomed on both printing tests—Regain Keyboard Control After Print Command and Time to Complete Printing. Buying Big Blue may guarantee job security, but it won't guarantee speed on several of our other tests.

DisplayWrite 4.2 was last on four of them. Since a stopwatch was used for testing, times of less than a second were rounded up to 1.0 second.

Relative Times
(WordPerfect 5.0 (OS/2) = 100)

ENDS

making you search for specific text.

If you want to exchange *Word* documents with users of other software, you'll have to either buy a conversion program or hope that the other software comes with a conversion program of its own. *Word* can export files in ASCII format and Microsoft's Rich Text Format (for exchange with *Word* for the Macintosh), and it

comes with a utility to convert files into IBM's DCA format. Beyond that, you're on your own.

TECHNICAL SUPPORT

Microsoft's technical support staff is knowledgeable and polite, as they should

be when answering calls that you have to pay for. Unfortunately, tech support wasn't able to offer fast fixes for the many incompatibilities between the first release of *Word* and many combinations of VGA adapters and hardware, including problems with some all-IBM machines.

Microsoft ships only one version of *Word*, which you can install for DOS,

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BEYOND THE BIG GUYS: The Best of the Other Word Processors

by Edward Mendelson

PC Magazine's editors winnowed the 55 packages tested in our word processing blockbuster (February 1988) down to five Editor's Choices: *Nota Bene* 2.0, *Q&A Write*, *Microsoft Word* 4.0, *WordPerfect* 4.2, and *XyWrite III Plus*. The story on *Word* 5.0 and *WordPerfect* 5.0 is updated in the accompanying evaluations. What's the latest news on the others?

The best package for manipulating text remains Dragonfly Software's $495 *Nota Bene* 3.0, with a major upgrade to 4.0 due around this fall. *Nota Bene* began as a word processor for academics and has grown into a matchless instrument for creating, modifying, and formatting all forms of text. Its keyboard is densely but logically organized and includes conveniences like keys that scroll two windows simultaneously, a smart quotation mark key that automatically senses whether to insert an opening or closing quotation mark character, and one-keystroke transpositions of words, sentences, and paragraphs. It remembers the last ten search and replace strings and has a five-level undelete buffer. *Nota Bene* provides a richly customizable system of collapsible outlines, footnotes, tables, and cross-references, and its built-in textbase lets you access megabytes of files in seconds. A $165 add-on bibliography program automates repeated references for legal and academic work.

Nota Bene gets its jackrabbit speed from a souped-up version of the *XyWrite* engine but adds scores of functions that *XyWrite* itself doesn't have. All of its hundreds of functions are available from Lotus-style menus, but advanced users can jump to a smart command line that lets you cycle through earlier commands to save retyping. If you don't need graphics capa-

bilities, you may find that *Nota Bene* surpasses both *Word* and *WordPerfect* in its powers as a text processor.

Symantec's $199 *Q&A Write* remains a smooth performer in the executive class. The original character-mode

version is still available, while a new version, *DeskMate Q&A Write* (also $199), comes with a runtime version of Tandy's *DeskMate* graphic interface. Both versions use clear and logical menus. The built-in database, with up to 1,000 records, lives up to expectations raised by the high-powered *Q&A* database package. The *Q&A* package is weak in formatting features, but the new *DeskMate* version imports some graphic formats and includes a graphic page preview.

For expert users, XyQuest's *XyWrite III Plus* remains almost identical to the version reviewed last year—still the lean, command-driven speed demon favored by hard-bitten journalists. For timid beginners, the *A La Carte* menus shipped with recent copies of the program make the program's interface more inviting. A major upgrade is rumored for late this year or early next.

During the past two years at least one other program has ascended into the heights reached by 1988's Editor's Choices: Software Publishing's *Professional Write*, now in Version 2.1, equals or betters *DeskMate Q&A Write* in its formatting, graphics, and database functions and manages to be even easier to learn and use. Printer and font support is especially strong. Neither of these executive word processors has footnote features, but if limited disk space and budget make you hesitate to choose a full-featured package, *Q&A Write* or *Professional Write* offer surprisingly effective alternatives.

One other contender, *Lotus Manuscript* 2.1, is prominent for its equation editor and large-scale outlining, despite a totally non-WYSIWYG editing screen. But the new *WordPerfect* 5.1 will have even better equation support, and *Word* 5.0 offers outlining with greater convenience and flexibility. ∎

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OS/2, or a network. When running under OS/2, *Word* is functionally the same as when running under DOS except for some arcane limits on mouse functions. Running *Word* under OS/2 also eliminates the bottlenecks that often make *Word* frantically flash a message to save your file when you perform memory-intensive tasks.

Word has no rival in ease of formatting, and its outliner is the best in any word processor. Its ability to edit different parts of the same file in different windows on the same screen is indispensable. Although its printer control is strong, it no longer leads the industry, and its foreign-language and scientific support is limited. But if *Word*'s manifold and impressive strengths correspond to your needs, you will find it one of the most convenient and powerful programs on the market.

WordPerfect 5.0

Nothing could be emptier and more simple than *WordPerfect*'s editing screen, with a laconic status line in the lower-right corner and acres of blank space to write in. And nothing could be more plentiful and elaborate than the gigantic network of features hidden beneath.

That combination of simplicity and power makes *WordPerfect* the $495 colossus of word processors, a giant both in its range of functions as well as in its share of the market. WordPerfect Corp.'s powerhouse can be found on every variety of system from the Apple II and the Macintosh to the Amiga, Atari, VAX, IBM 370, and on

WORDPERFECT 5.0
Suitability To Task

Personal	
Professional	
Corporate	
Legal	
Desktop Publishing	

to OS/2 and Unix machines.

WordPerfect serves the whole spectrum of users while serving the whole spectrum of computers. Beginners can create and print a file after learning to use two or three function keys. More-advanced users learn other function keys that lead to modest-looking one-line menus; only in the submenus one more level down does *WordPerfect*'s enormous range of options and functions finally become apparent. (Version 5.1, due to appear by the time you read this, will have mouse support and optional pull-down menus that let you forget the function keys altogether.)

WordPerfect serves corporate and academic users by being the most communicative of word processors. It lets you share files with minimum effort and maximum compatibility. If you create a document with fonts and layouts tailored to your PostScript typesetter, you can hand the file to a colleague with a 9-pin dot matrix printer, and his copy of the program will automatically produce the best possible approximation of the original. You need give your colleague only one file because *WordPerfect* documents are self-sufficient enough to carry their stylesheets and graphics with them.

WordPerfect is highly hospitable to files created by other software. Built into the program is a smart ASCII import that optionally strips excess carriage returns. A conversion program imports and exports documents in DCA, *WordStar*, *MultiMate*, and other formats, and imports but does not export *Word 4.0* files. Version 5.1 will add links to spreadsheets and automatically update the links whenever you load the *WordPerfect* file; 5.1 will also read virtually any database file.

INTEGRATED FUNCTIONS

All of *WordPerfect*'s functions are integrated, so that if, for example, you choose another printer driver, all related options change automatically—the printer port, the default type style and size, the sizes of superscripts and headings, even the paper size. *WordPerfect* does the tedious work of reformatting and leaves you to get on with the work of thinking and writing.

No other word processor approaches *WordPerfect*'s virtuosic control over more than 450 printers. You can make fine adjustments in the average spacing between letters and words. You can designate one page in a file as printed letterhead, another

as standard letter paper, another as an envelope—and each prints in the correct orientation, using paper taken from the correct slot on the printer. *WordPerfect*'s printer drivers are full-fledged programs with variables and branching, rather than mere lists of data, yet a supplied printer-definition program lets you modify or create drivers using simple menus. (The manual for the printer-definition program costs an extra $19.95.)

In its handling of foreign and technical characters, *WordPerfect* is rivaled only by

> *WordPerfect* handles pictures with the same aplomb it brings to type. You can rotate, size, stretch, or crop an image, and position it at any point on a page or insert it into a line of text like a character.

Nota Bene. You can enter 1,700 characters, including Greek, Hebrew, Cyrillic, and Japanese, from the keyboard using a "compose" key that inserts an "é" when you type an "e" and an apostrophe or inserts less-common characters when you enter numerical codes for the 15 character sets listed in the manual. If you don't like typing 4,23 to enter the copyright symbol, you can automate it with a macro.

A text screen attached to an EGA, VGA, or Hercules card can display 512 different characters, and all 1,700 can appear on the graphic page preview, which zooms in to 200 percent magnification. You won't get nasty surprises when you try to print special characters, because the graphic preview displays a character only if your printer's fonts can print it. In Version 5.1, if your fonts don't include the character you need, *WordPerfect* will print it by generating it as a graphic—a spectacular convenience for foreign-language work, matched by 5.1's new feature that can display and print any equation as a graphic.

WordPerfect handles pictures with the

WordPerfect's unique graphics-editing screen lets you rotate and resize images or move them within a frame. You can't modify individual pixels, but you can do anything else to manipulate the image.

WordPerfect lets you edit recorded macros or create programmed macros using a macro-editing screen. The menu at the upper right lets you enter programming commands into a macro.

WordPerfect's page preview zooms to fine details of layout. Notice the wide spacing in the all-capitals text, a typographic effect achieved with WordPerfect's advanced printer controls.

same aplomb it brings to type. You can rotate, size, stretch, or crop an image, and position it at any point on a page or insert it into a line of text like a character. *WordPerfect* uses measurements as small as 0.00083 of an inch, so you can specify the width and location of graphics lines and boxes to the limit of a printer's ability.

WordPerfect lets you put a box around text using any style or shading you like. In Version 5.0 this function is powerful but

WordPerfect's footnotes offer a combination of great power and minor inconvenience.

clumsy because you can't see boxed text on the normal editing screen; in 5.1, boxes, tables, and side-by-side columns will be produced effortlessly by moving the cursor around an ingenious table editor.

TEXT FORMATTING

You can apply virtually any formatting to text in a *WordPerfect* document, although sometimes you have to use roundabout methods. You can't specify paragraph formats as straightforwardly as in other programs. You have to insert an unintuitive code if you want headers or footnotes to print in the font you choose. For a hanging indent you press the Indent key to indent the paragraph, then press the Margin Release key to move the first line back to the margin. (Margin Release key? On a word processor?) These indent codes move the cursor to a tab stop, which means that your paragraph formats will change in ways you may not like when you reset your tabs. At the start of a hanging-indented paragraph, the cursor jumps bewilderingly forward and back on screen as it moves through the format codes. To edit such paragraphs safely, you have to split the screen between the normal editing window and a window that lets you tinker directly with the codes.

WordPerfect's styles let you incorporate text and format codes into a kind of supercode whose content changes when you change stylesheets. The effects are more elaborate than *Word's* styles, but less convenient to apply because you choose styles from a menu and have to write macros if you want to apply them with only one or

We've got the guts, you get the glory.

two keys. If you don't use styles, you have to write macros to make global format changes in a file. WordPerfect has no direct way of transforming all underlined text to italic, and even more-complex changes require elaborate macro programming.

WordPerfect's footnotes offer a combination of great power and minor inconvenience. You can have footnotes and endnotes in the same file, and you can reference them with letters, numbers, or symbols. But you can't edit a footnote on the same screen with the main text, and to make a search or replace operation extend into footnotes, you have to remember to press Home before the Search key. Footnote numbering can be restarted at any number and isn't disrupted by formatting changes as it can be in *Word*. Automatic cross-referencing links notes, tables, pages, and graphics. One reason *WordPerfect* is popular in law offices is its built-in support for the special abbreviations and formats used in legal citations. *WordPerfect* does create outlines but can not collapse them so that only the higher levels are visible.

WordPerfect's speller lacks a whole-word option but lets you remove or add words from the main dictionary so that

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> legal citations.

they appear among the alternatives for misspelled words. You can insert codes in a document that make *WordPerfect* switch to another dictionary when it reaches that code—an ideal feature for files that use more than one language.

KEYBOARD INTERFACE

WordPerfect's keyboard interface generally puts related functions on different states of the same key, but some assignments seem capricious: the speller, for example, is on Ctrl-F2, the thesaurus is on Alt-F1. Block moves and copies require excess keystrokes. To reach the beginning of the text in a file you press "Home Home Up";

but you press Home three times, then Up, to reach the beginning of the codes in the file. Although you normally complete a command by typing a string and pressing Enter, with the Search key you type the search string and then press the Search key again. This lets you search for carriage returns without entering the special codes required by other programs, but it's an inconsistency that can waste more time than it saves.

WordPerfect lets you create macros by recording keystrokes or using a built-in macro editor that includes variables, branching, and even lets you create menus that replace the ones designed by Word-Perfect. A sample macro supplied on the disks makes a calculator pop up on the editing screen. Mail-merge in 5.0 doesn't directly support variables, but 5.1's revamped mail-merge will be fully programmable.

You get only two windows for editing files, but you can view a third file from the directory screen. That same directory screen supports extensive file management as well as word and document searches, including searches in document summaries. If you use the $129 *WordPerfect Library*—with its intelligent DOS shell, calculator, calendar, small database, macro editor, and other utilities—you can capture text from the screen and transfer it to any application. *WordPerfect Office*, a $495 package for use on networks ($150 for each extra station), expands on *Library* to

EDITOR'S CHOICE

● Microsoft Word   ● WordPerfect

Chances are you already use either *WordPerfect* or *Microsoft Word*. If so, there's no compelling reason to switch. There's also no strong reason to switch if you use any of the Editor's Choices from our word processing blockbuster of 1988. At that time, we gave the nod to five programs: *Nota Bene*, *Word*, *WordPerfect*, and *Sprint*—among high-end programs, plus *Q&A Write* among professional programs. Two others have made enormous strides in recent months, *Lotus Manuscript* in the high-tech arena and *Professional Write* in the executive suite. If you use any of these programs and are satisfied with their features, stay with what you've got.

If you use almost anything else, it's probably time to start over, and you won't regret choosing either *Word* or *WordPerfect*. The market has tilted decisively toward *WordPerfect*, and for the majority of users, the market has made an excellent choice.

WordPerfect has the greatest depth and range of features, the fullest control over the printer, and the best technical support in the industry. Corporate users can install versions of *WordPerfect* on platforms ranging from Unix and DEC machines through the IBM 370 and the Mac. *WordPerfect* has the full resources of a dynamic corporation behind it; it has the best features and support now and the most promise for the future. Version 5.1, due around the time you read this, improves the awkward spots in the keyboard interface.

Microsoft Word shines in the ease with which it lets you apply and alter

formatting. Its stylesheets require some initial effort in learning but let you construct complex and repeatable page formats with a few keystrokes. Its collapsible outlines make large files manageable and convenient. *Word* was always strong in printer support, but *WordPerfect* has set a new standard that *Word* hasn't tried to approach.

Word 5.0 is smoother and more powerful than earlier versions, but its growth has slowed, and Microsoft seems to be turning its energies away from DOS-based *Word* and on to the forthcoming *Word for Windows*, scheduled to arrive late this year or early next. *Word for Windows* may open the era of serious WYSIWYG word processing. When that happens, all the honors will suddenly be up for grabs again.

include e-mail and scheduling.

A "master document" feature in Version 5.0 lets you incorporate other files as "subdocuments" that can be edited and modified separately and then printed as a single large file with continuous pagination, cross-referencing, and footnotes. *WordPerfect* can compare a file on-screen with a file on-disk and automatically redline or strike through any changes or rearrangements. Nonprinting comments added to files can be converted to printable text but, unlike *Word*'s invisible text, they can't be reconverted automatically into comments.

A refreshingly intelligent installation program checks out your system to make sure *WordPerfect* will work correctly from the start. Once inside *WordPerfect* itself, the help system is extensive enough to let you ignore the manual until you need to work with complex functions like merging, sorting, and math. In Version 5.0, the help system makes you consult an on-screen index if you don't know which key has the function you need help with; the help in 5.1 will be context sensitive.

Version 5.0's looseleaf manual is arranged alphabetically rather than logically and doesn't document all features; 5.1 will be better documented. A disk-based tutorial gets your feet wet in the program's basic

techniques, and a 400-page workbook takes you into the program's depths. If all else fails, you can get fast and usually knowledgeable advice by calling a toll-

> **WordPerfect is the industry standard and also the flagship of a company dedicated to maintaining its dominance. Its control of the printed page makes other word processors look crude by comparison.**

free number. *WordPerfect*'s customer support is by far the best in the industry.

Minor updates of *WordPerfect* appear every six weeks to two months and cost $10 or more, depending on the number of disks involved. You can even order a subscription and use one copy to update an entire office. These updates include minor bug-fixes as well as improved features and

new options on the menus. *WordPerfect 5.0*'s first release, for example, didn't support landscape graphics on the LaserJet and didn't include kerning tables; later updates have both.

A $549 OS/2 version of *WordPerfect 5.0* has the same features as the DOS version except that it displays a session number on the status line if you open multiple copies of the program. A Presentation Manager version is due in 1990, with a *Windows* version a distinct possibility soon after.

WordPerfect is the industry standard and also the flagship of a company dedicated to maintaining its dominance. *WordPerfect*'s control over the printed page makes all other word processors look crude by comparison, and it combines an unequaled power with an interface that makes basic functions simple. The program's main weakness lies in the fact that some of its most powerful functions, including those that format a page, are more awkward to use than they need to be. But *WordPerfect* is the word processor that an individual and corporate users can buy with the utmost confidence that it will meet their needs both now and in the future. ■

Edward Mendelson is a contributing editor of PC Magazine.

EDITORS' CHOICE

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EDITORS' CHOICE

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Mo.   Day   Yr.

Address   Street   Apt #   City   State   Zip   Home Phone
(   )

Date of Residence: Month   Year   Monthly Payment $
Residence: From   To   Buy   Rent   Own

Your Employer: (if self employed, see rear panel)   Date of Employment: Position: Monthly Income:
From   To   Gross $ Net $

Employer's Address   Address   City   State   Business Phone
(   )

Previous   Address   Dates of
Employer: Employment:
Income from alimony, child support or   Other income: Monthly Income:
separate maintenance payments need   Gross $ Net $
not be disclosed if you do not wish   I have received since   Relationship
to have it considered as a basis for
repaying this obligation   Monthly Income:

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Bank Account: ☐ Checking
☐ Savings
Bank Account: ☐ Checking
☐ Savings
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Other
Card Reference:

Other Credit References: Account No.   Expires

Driver's License No.   State   Expires

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Mo.   Day   Yr.

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(   )

Employer: Date of Employment: Position: Monthly Income:
From   To   Gross $ Net $

Employer's Address   Street   City   State   Business Phone
(   )

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Complete this section only if you are self employed

Business Name   ☐ Proprietorship   ☐ Corporation   ☐ Partnership

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Your annual   Business   Business
income from business   annual income   (gross)   (net)

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25-MHz 386s
Eclipsed but Still Shining

**For only a fraction more than 20-MHz PCs,
25-MHz 386s offer speed at prices that are relative
bargains. PC Labs tests 13 new machines with
stringent Class B credentials.**

by Catherine D. Miller

The 25-MHz 386 chip was never expected to reign as the PC speed king for long. The 486 was more than just a rumor, and news of the impending introduction of the 33-MHz 386 eclipsed the 25-MHz 386 while it was still in its infancy. Less than a year after introducing the 25-MHz 386 in April 1988, Intel shipped the 33-MHz processor, and the 25-MHz 386 was relegated to the midrange of high performance. Yet the 25-MHz 386 still offers incredible performance for the price, and this price/performance value should only get better.

So many processor choices have made the PC market more than a little confusing. Intel's 32-bit processor lineup already includes the hybrid 16-MHz 386SX, and the 16-, 20-, 25-, and 33-MHz 386. Early next year Intel will ship the 20-MHz 386SX, and the 25-MHz 486 will replace the 33-MHz 386 as the state-of-the-art 32-bit processor.

Meanwhile, the fact that 286-based machines are still selling so well indicates how price-sensitive the market is. Intel's price structure will have a profound effect in determining which processors will survive the inevitable pruning of future PC choices. As of the fourth quarter of 1989, Intel lists the 16-, 20-, and 25-MHz 386 processors at $173, $184, and $192, respec-

tively (quantity 1,000); the 33-MHz 386 is priced at $278. The 25-MHz chip has experienced the biggest drop in price over the year, amounting to more than half of its original first quarter 1989 price of $425. Factor in the 386SX selling at $80, and the upcoming 20-MHz SX chip, and the 16- and 20-MHz 386's survival is in doubt. But the 25-MHz 386 processor should remain secure. Since a 25-MHz 386 offers a 25 percent performance increase over a 20-MHz processor and costs only 4 percent more for the chip, its continued success seems assured.

ATTAINING HIGHER PERFORMANCE

Each of the 13 machines that we reviewed uses a minimum 32K high-speed static RAM (SRAM) cache to help the slower system memory keep up with the 25-MHz processor for near-zero-wait-state performance. Most of the units use the Intel 82385 cache controller. HiTech, Micro Labs, PC Craft, Unisys, and Wyse, how-

ever, have their own proprietary cache designs, while TeleVideo uses the Austek 38152 cache controller.

PC manufacturers enhance the designs of their systems to improve performance. Among the machines tested, HiTech, Tandon, and CSS don't offer the ability to use shadow RAM, which can speed up BIOS and video access. Only TeleVideo doesn't give you control over whether shadow RAM is implemented.

Control over speedup techniques such as shadow RAM and RAM caching allows you the flexibility to use software such as Lotus 1-2-3, Release 3.0, which needs the 384K RAM where shadowed ROM resides in RAM, and also expansion boards that wouldn't function properly if their memory addresses were cached. (See "Potent Medicine, Strong Side Effects" by Contributing Editor Winn L. Rosch for an overview of the pluses and minuses of

PC speed-up techniques.)

These 25-MHz machines have the power to tackle calculation-intensive applications such as CADD, desktop publishing, statistical analysis, and graphics. But do they have what it takes to perform the duties of a file server? To be an effective server, you need more from your PC than just fast performance. The PC's cabinet must be large enough to hold two hard disks and a tape drive. You'll need as much as 7MB RAM to run a powerful operating system such as NetWare/386 with several hard disks, a tower case, three serial and two parallel ports, an empty slot for your network adapter card, and if you use Ethernet with its difficult T-connectors, and easy access to the back of the cabinet so you can attach the cables. Of the computers reviewed here, only the ACMA 386/25 Business System, the PC Craft 3500/25C, and the Tele 386-25 had all of these features, making them elegible for use as file servers.

OUT ON THE STREET: What PCs Really Cost

by Susan L. Hayes

Anyone familiar with the personal computer industry knows better than to pay a manufacturer's suggested list price. Discounts are everywhere, but the question remains: how low can prices go?

Posing as a brand-specifier looking for a good deal, PC Magazine chose seven 25-MHz 386 computers and questioned several national chains, such as ComputerLand and Businessland, as well as metropolitan dealers and direct-marketing companies to find the greatest discounts off list. Choosing comparable PCs from Compaq, Everex, IBM, Tandy, and Zenith, plus the direct-marketing Dell and CompuAdd, we found that the gap between the list price of a Compaq Deskpro 386/25 and the price of a mail-order CompuAdd 386/25 narrows down from $7,235 to about $3,500 as you shop around. There's more: IBM's PS/2 Model 70-A21 can sell for as low as $8,100—the same price as a Dell System 325. What's the catch?

NEVER PAY LIST PRICE AGAIN

We based our comparisons on similarly configured machines that had 4MB

RAM, at least a 100MB hard disk, VGA adapter, and monitor. Compaq's DeskPro 386/25 with a 110MB hard disk lists for $13,694. We found that 25 percent off list is the norm when buying through a dealer, with one New York dealer quoting $9,500, 30 percent off Compaq's list price. To cut costs further, we found that several dealers suggested putting a Paradise VGA card in the machine instead of Compaq's own for an additional $300 savings.

IBM's PS/2 Model 70-A21 with a fixed 120MB hard disk, lists for $11,113. IBM's standard corporate discount is 25 percent, but most dealers seemed willing to offer a similar break on single machines, with prices ranging from $8,000 to $8,300. However, nothing's guaranteed: our worst case was $9,550, a paltry 14 percent off list.

Everex, a company increasingly compared with Compaq and IBM in terms of speed and quality, offers comparable prices as well. With a 150MB hard disk, the Step 386/25 lists for $11,124. Everex said that dealers routinely slash an incredible 38 percent off list. Expect 25 percent. A similar discount proved true for Zenith's Z-386/25 as well. Listing for $12,096 with a

150MB hard disk, Zenith is sold through authorized dealers nationwide at an average street price of $9,072.

The Tandy 4025LX with a 170MB SCSI hard disk lists for $9,278. Radio Shack dealers regularly discount Tandy systems by about 10 to 15 percent. Tandy offers significant discounts to corporate accounts buying in quantity.

Street prices can be unpredictable, though, with prices quoted over the phone often reflecting more the mood of the salesperson than the dealer's standard discount. But one comforting aspect in the search for the ultimate street price is that discounts nationwide usually fall within established boundaries of 20 to 30 percent off the suggested list price. Because the prices of identical systems vary only slightly among dealers in New York, Dallas, or Chicago, it's not necessary to canvass the entire country for fear of not landing that big bargain.

LESS DISORDER IN MAIL-ORDER

Early in its evolution, mail-order buying was fraught with disasters. Luckily this has changed, and the process has advantages, such as avoiding sales tax on out-of-state purchases. Further-

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THE SELECTION PROCESS

PC Magazine used several criteria in selecting the computers for this review. Since we had already looked at 25-MHz systems twice this year, we decided not to include the 25-MHz 386s reviewed in either the February 14, 1989, or May 30, 1989, issues. The machines reviewed for this issue must have been available by mid-July. We requested complete VGA systems with 4MB RAM, a 100MB or larger hard disk, and processor RAM cache of 32K or greater.

We then selected the 25-MHz systems that had received FCC Class B approval or had submitted the required paperwork well before our July 15 deadline. Why Class B? All PCs generate radio frequency (RF) emissions that can interfere with other electronic devices designed to receive RF communications. The Federal Communications Commission has prescribed two sets of guidelines to reduce the amount of emissions from PCs. Class B machines are

more strictly regulated and emit less interference. The less stringent Class A is typically known as the office-equipment standard, since PCs given this rating are not to be used in the home. Class A is not monitored by the FCC: manufacturers are honor-bound to determine that their PCs comply with Class A standards.

Receiving an FCC Class B rating is a time-consuming and costly process. The manufacturer must submit a unit for inspection to the FCC along with documents, photos, and technical specifications for all of the system's components. Class B certification indicates that the machine produces RF emission levels low enough not to interfere with TVs and radios found in the home.

Yet FCC Class B ratings are also important for PCs that reside in offices. Walkie-talkies, cellular phones, and the telephone microwave system on the roof

of your office rely on RF reception. As processor speeds increase, so do RF emissions. In general, PC systems complying with Class B guidelines have better electronic design techniques, including adequate grounding and cable shielding, cleaner motherboard design, and more-sophisticated engineering.

All other things being equal, when you have a choice between otherwise equivalent Class A and Class B machines, you should choose Class B.

PERFORMANCE AND PRICE

While the differences in performances on the PC Labs benchmark tests among the machines reviewed here are important, they should not be the sole basis for making a purchasing decision. All the machines performed within the range expected for this class, with no single machine exceeding or falling short of the mark.

Three of the systems reviewed feature backplanes with the processor on a 32-bit

DEALER PRICES VS. LIST PRICES

	Compaq Deskpro 386/25	IBM PS/2 Model 70-A21	Everex Step 386/25	Zenith Z-386/25	Tandy 4025LX	Dell System 325	CompuAdd 386/25
List price	$13,694	$11,113	$11,124	$12,096	$9,276	$8,100	$6,459
Dealer price	$10,271	$8,113	$8,343	$9,072	$7,886	$8,100	$6,459
Discount off list price	25%	25%	25%	25%	15%	Mail order	Mail order

more, most companies offer a 30-day money-back guarantee.

An alternative to buying from dealers is the thriving industry of reselling big-name machines through the mail; companies that do so include Bulldog and Arlington Computer Products. Prices for Compaq and IBM—both for single units and small bulk orders of approximately 20 machines—hover around a 30 percent discount. Everex and Zenith systems are much harder to find through mail-order resellers.

With all of the discrepancies among local and national dealers, you might wonder if any machine sells for list price. Yes, Virginia, list equals the selling price at direct-marketing companies like Dell and CompuAdd. A CompuAdd 386/25 with a 150MB hard disk lists for $6,459 and sells for $6,459. Compare this with the IBM Model 70 A-21's average price of $7,800 from mail-order resellers, and the gap between the two products is less than $1,500—quite a difference from the $4,500 rift between list prices.

Buying a computer "on the street" takes some time and energy, but you can save yourself big bucks in the long run. You'd better shop around. ▪

expansion card. The AST Premium 386/25, Tele 386-25, and the WYSE-system 386 Model 3225 all feature this design. By replacing the processor card with one more powerful, a 25-MHz 486 for example, you could upgrade the system without abandoning the box. Only AST has announced plans to ship a 486 upgrade card: for $3,695 and the return of the processor card, you'll be able to purchase the FASTboard 486/25.

List prices for the standard VGA configurations of the machines we tested started at a low of $2,950 for the HiTech SAM 3001/386-25 with 4MB RAM, an 85MB hard drive, a VGA card, VGA monitor, and DOS 4.01. The highest list price of the group, $15,141, was for the dealer-distributed and heavily discounted Unisys PW² 800/25A workstation, equipped with 6MB RAM, a 140MB hard drive, VGA monitor, and DOS 4.01. But if you're cost-conscious, looking at list prices won't give you an accurate idea of what you'll really pay (see the sidebar "Out on the Street: What PCs Really Cost" on street prices). To give you some basis for comparison, we've indicated the distribution channels used by each manufacturer to market its products.

ACMA COMPUTERS INC.
ACMA 386/25 Business System
by Bruce Brown

Personal computers are usually surprisingly reliable, even with all the stories about hard disk drives failing whenever they're loaded with crucial, non-backed-up data. For all the claims of hardware reliability, however, astute purchasers, especially people buying high-performance computers, look for all the vendor support and backing they can get in case of hardware problems. ACMA Computers of Fremont, California, has blended an interactive combination of a 45-day money-back guarantee, unlimited toll-free telephone support, and a two-year system warranty. By going an extra measure or two to demonstrate a willingness to support users and keep satisfied customers, ACMA is putting its policies where its mouth is.

ACMA's entry in the 386 25-MHz world is the ACMA 386/25 Business Sys-

ACMA 386/25 Business System
ACMA packs 4MB RAM, a 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, 80387-25 coprocessor, and a 375-watt power supply into the tower case of its 386/25 Business System. Add a NEC MultiSync 3D monitor and a two-year warranty for just $5,995.

tem. The standard unit is a desktop model, but the test unit came with a vertical (tower) case, measuring 7.25 by 24.5 by 16.75 inches (HWD). The tower model has room for six half-height drives stacked vertically, all of which can have removable media. The $1,895 base model includes 1MB RAM with a 64K RAM cache; your choice of a 1.2MB or 1.44MB floppy disk drive; one parallel, two serial, and one game port; an MFM 1:1 interleave combination floppy/hard disk controller, and a selection of utility software.

ACMA specified a price of $3,595 for our standard configuration system, which consists of 4MB RAM, a 120MB RLL hard disk drive, VGA monitor, and MS-DOS 4.01. For the tower unit tested, including 4MB of RAM, both 1.2MB and 1.44MB floppy disk drives, an extra-powerful 375-watt power supply, a Toshiba 150MB SCSI hard disk drive with drive controller upgrade, an 25-MHz 80387 math coprocessor, a 16-bit ATI VGA Wonder Board, and a NEC MultiSync 3A, the price was still a decent $5,995.

The ACMA machine uses a Micronics motherboard, the Chips and Technologies 386 chipset, and a Phoenix BIOS. This combination, along with the 35-nanosecond 64K RAM cache and 80-ns. system RAM, helped the ACMA to score very

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well in the processor-determined benchmark tests, the Conventional Memory test, and in the DOS File Access (Large and Small records) tests. ACMA's video test scores are also good. Processor speed is 25 MHz but can also be reduced to 6 or 8 MHz if necessary. At each of the three processor speeds, the ACMA expansion bus clips along at a safe 8.33 MHz.

The ACMA motherboard can hold a total of 8MB in DIP-style chips, with the single 32-bit expansion slot capable of handling another 8MB on a 32-bit memory card. The Micronics motherboard uses memory interleaving and has a user-selectable video and ROM BIOS shadowing capability. The memory cache is not expandable; all versions of the machine come with 64K of 35-ns. static RAM, run by an Intel 82385 controller chip. The expansion slots include the single 32-bit slot and five 16-bit slots.

The ACMA's standard power supply is 200 watts, though the five-lead 375-watt unit on our test model is a wise upgrade if you're going to load up with drives and memory. The vertical case also has plenty of space on the inside, so even with a full house of drives, boards, and memory there is still enough room for adequate ventilation.

ACMA includes a Maxi-Switch 101 key keyboard, which is 18.25 inches wide by 8.25 inches deep and has a 72-inch cable connected to the center rear.

ACMA sells computers by mail order and through a direct sales staff. All ACMA machines come with a reassuring 45-day no-questions-asked money-back guarantee with no return fee. There is also toll-free technical support, as well as a two-year warranty, the first year covering both

parts and labor and the second year covering labor only. The extra year is an unusual but welcome feature, since computer labor fees often start at about $65 per hour with a 2-hour minimum.

In all the ACMA 386/25 is a good combination of performance, fine components, good expansion possibilities and better-than-average warranty and support policies—all at a reasonable price. If you're looking to buy a computer by mail order but still want a company that will stand behind what it sells, the ACMA 386/25 is a good bet.

Amax PC/386-25

by Bruce Brown

There's a lot to be said for straightforward competence in microcomputers. Especially when you get to relatively fast machines like 25-MHz 386-based computers, which just a year ago were the fastest on the market, finding a competent machine with proven components is reassuring. The Amax PC/386-25 from Amax Engineering has all the markings of a solid workhorse machine, with no outlandishly fast speeds in any one area but with no questionable design components or tricks, either.

The Amax machine is sold only through dealers and value-added resellers (VARs). Amax sells a base unit with everything but video components for $3,400. The base system includes 1MB of RAM with a 32K RAM cache; either a 1.2MB or 1.44MB floppy disk drive and a 40MB hard disk (not enough if you're going places with a 25-MHz machine, but at least a start); one parallel, one game, and two serial ports; and various utility software. A machine with 4MB of RAM, a 32K RAM cache, a 150MB SCSI hard disk drive, an 80387-25 math coprocessor, 8-bit VGA card and monitor, and DOS 4.01 lists for $5,455. Our test system, which had a 16-bit Western Digital VGA card with a NEC MultiSync 3D monitor plus a larger, 64K RAM cache, costs $6,750—an attractive price for the components included.

The Amax system unit is a desktop box measuring 6.5 by 21 by 16.75 inches (HWD). The case can handle five half-height drives, three of which can use removable media. It looks like a fairly standard AT-style case with lights for power, hard disk access, and turbo operation, as well as a reset button and keylock all located on the front. The supplied keyboard is an enhanced Maxi-Switch unit with a 72-inch cable; the standard power supply delivers 220 watts and comes with four device leads.

The PC/386-25 scored well on all of the benchmark tests, a fine showing in a very fast field. While it can't claim to be one of the fastest boxes, it is certainly a 25-MHz 386 machine, judging by performance scores alone. If you look inside the box, you'll see the standard Intel 80386 25-MHz chip run by a 50.00-MHz clock crystal on a Micronics motherboard bearing the standard Chips and Technologies 386 chip set and a Phoenix BIOS. There is a socket for either an 80387-25 math coprocessor or a Weitek chip, but not both.

The processor can run at 6, 8, or 25 MHz, with the expansion bus staying at a constant 8.33 MHz no matter what the processor speed. There are eight expansion slots; one 32-bit, five 16-bit, and two 8-bit. Our test machine had separate floppy and hard disk controllers because of the SCSI hard disk upgrade; this setup wasted an expansion slot unnecessarily. If you need all the expansion slots, specify a combination SCSI drive controller.

Amax PC/386-25
Amax opts for dependable performance and compatibility rather than speed. With 4MB RAM, a 150MB hard disk, VGA monitor, 80387-25 coprocessor, and DOS, the PC/386-25 lists for $5,455.

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25-MHz 386-BASED PCs: SUMMARY OF FEATURES

(Products listed in ascending price order)

The following commentary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as in the left-hand column of the table.

Basic configuration This price represents the most stripped-down machine the vendor will sell, typically including 1MB RAM, one floppy disk drive, and serial and parallel ports.

Hard disk options The number of different hard disks the vendor offers for a machine is often indicative of how much customizing is available.

Standard configuration For the sake of price comparisons, our "standard" configuration normally includes 4MB RAM, a hard disk of at least 100MB, one high-density floppy disk drive, a VGA monitor, at least one parallel and one serial port, DOS, and a keyboard. Because the "standard" packages cited here may differ from this configuration, the price of each system is

followed by the size of the hard disk and any other departures from our specification.

Tested configuration The specifications of the evaluation units depend on what configuration each manufacturer has sent us (based on our guidelines).

Bus disk speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 MHz.

Disk controller manufacturer and type Disk encoding techniques currently include RLL (Run Length Limited) and the older MFM (Modified Frequency Modulation) scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. Nine such bits would be needed to store 12 bits of data in MFM format, and only six polarity changes are required with RLL format; thus, MFM takes more space than RLL but provides a more stable environ-

ment and is more commonly used. ST-506 technology, for instance, uses the MFM encoding scheme.

Two other common disk transfer interfaces are SCSI (Small Computer System Interface) and ESDI (Enhanced Small Device Interface). Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers.

The BIOS version and date may affect PC Labs' benchmark test results. Those purchasing the same machine with a different BIOS version are likely to encounter some variations in performance.

Memory chip type Kb and Mb refer to kilobits and megabits, respectively.

Chip packaging Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs. The Dual In-line Package (DIP) is the traditional buglike computer chip sprouting 8, 14, 24, or even 40 or more metal legs (evenly divided between right and left sides).

BASIC CONFIGURATION	SAM 3001/386-25	ACMA 386/25 Business System	CSS Select 386-25	Micro Labs 386/25	Proteus 386-MX25	Tandon 386/25
List price	$1,595	$1,695	$2,800	$2,995	$2,995	$3,051
Basic configuration includes	2MB RAM, 1.2MB floppy disk drive, tower case	1MB RAM, 1.2MB or 1.44MB floppy disk drive; 2 serial, 1 parallel, and 1 game port; utility software	1MB RAM, 1.2MB floppy disk drive, 2 serial and 1 parallel port	1MB RAM, 40MB or 1.44MB floppy disk drive, 1 serial and 1 parallel port	1MB RAM, 1.2MB floppy disk drive, 2 serial and 2 parallel ports, diagnostics and utility software	1MB RAM, 1.2MB floppy disk drive, 2 serial and 2 parallel ports, DOS 3.3, GW-BASIC, Microsoft Windows 2.03
Drive bays	6 half-height	6 half-height	5 half-height	5 half-height	5 half-height	5 half-height
OS/2 available	❑	❑	❑	❑	❑	❑
Hard disk options (MB)	43, 65, 85, 120	30, 50, 65, 72, 80, 110, 120, 150, 300	80, 106, 182, 383	40, 65, 80, 120, 145, 300	40, 45, 85, 150, 340, 700	110, 330
Slots	One 32-bit, five 16-bit, one 8-bit	One 32-bit, five 16-bit	Two 32-bit, four 16-bit, two 8-bit	One 32-bit, six 16-bit, one 8-bit	One 32-bit, six 16-bit, one 8-bit	Five 16-bit, two 8-bit
Slots free with hard and floppy disk drives, video, two serial and one parallel port installed	4	5	5	5	5	4
Power supply (watts)	220	200	200	200	200	190
Keyboard cable length (inches)	72	72	72	80	72	80
STANDARD CONFIGURATION						
Price of VGA system with 4MB RAM, monitor, DOS	$3,250 (120MB hard disk)	$3,595 (120MB hard disk)	$5,590 (106MB hard disk)	$4,895 (120MB hard disk)	$5,222 (150MB hard disk)	$7,099 (5MB RAM, 330MB hard disk)
80387 coprocessor	$495	$525	$525	$525	$561	Unavailable
TESTED CONFIGURATION						
List price	$3,250	$5,995	$5,700	$5,590	$5,225	$5,955
Tested configuration includes	4MB RAM, 120MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, DOS 4.01	4MB RAM, 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, MultiSync 3D monitor, 80387-25, DOS 4.01, GW-BASIC, 375-watt power supply, lower case	4MB RAM, 89MB hard disk, 1.2MB floppy disk drive, VGA adapter, 80387-25	4MB RAM, 145MB hard disk, 1.2MB floppy disk drive, VGA monitor, DOS 4.01	2MB RAM, 150MB hard disk, 1.2MB floppy disk drive, NEC MultiSync 3D monitor	1MB RAM, 330MB hard disk, 1.2MB floppy disk drive, VGA monitor, 30MB Personal Data Pac, DOS 3.3

■—Yes   ❑—No

N/A—Not applicable: the product does not have this feature.

Single In-line Packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. Single In-line Memory Modules (SIMMs), on the other hand, are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement duplicates the integrated structure of a SIP but allows for the possibility of replacing an individual memory component if necessary.

RAM chips RAM chips come in two basic types: static and dynamic. Static RAM chips (SRAMs) are faster and more efficient but costlier. Dynamic RAM chips (DRAMs) cost less and are more common, but the tradeoff is in slower processing and operation.

Interleaved memory CPU speed is usually faster than memory speed. Interleaved memory increases processing speed by splitting the memory into two or more portions. The CPU then sends information to a

section at a time, allowing one section to process while another receives data.

Shadow RAM Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed at the cost of 384K of memory in the first 1MB of system RAM.

Disk cache software Some companies provide software to facilitate data retrieval from the hard disk. This software speeds overall system performance by anticipating what data the processor will need next.

Maximum 32-bit RAM Many computer manufacturers have designed their own 32-bit slots for memory expansion cards. The availability of such slots is especially important for a growing number of memory-intensive applications.

Processor RAM cache A processor RAM cache acts as a bridge between the CPU and the slower

main memory. The cache is comprised of a small bundle (typically 32K to 128K) of fast SRAM chips. The cache controller is designed to predict and retrieve the data the CPU is likely to require next, thus preventing wait states. There are two varieties of controllers: discrete-logic chips (designed by the individual manufacturers) and third-party VLSI chips like the Intel 82385.

FCC certification class Two classes of FCC (Federal Communications Commission) approval may be given to computers: Class A and Class B. These classes concern levels of radio-frequency interference. With Class A approval, a computer may be operated in a business locale. The tougher Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

Certification tests must be performed by private testing companies. The passing results are then sent to the FCC for final certification, a process that can take several months.

	Amax PC386-25	Mitac MPC-4000F	PC Craft 3500/25G	AST Premium 386/25	Tela 386-25	Unisys PW² 800/25A	WYSEsystem 386 Model 3225
	$3,400	$5,195	$5,569	$5,695	$5,995	$7,315	$7,599
	1MB RAM, 40MB hard disk, 1.2MB or 1.44MB floppy disk drive, 2 serial, 1 parallel, and 1 game port; utility software	1MB RAM, 1.44MB floppy disk drive, 2 serial and 1 parallel port, DOS 4.01	4MB RAM	2MB RAM, 1.2MB floppy disk drive, 2 serial and 1 parallel port, utilities, DOS 3.3	4MB RAM, 1.2MB floppy disk drive, 2 serial and 1 parallel port, DOS 3.3	2MB RAM (no keyboard)	4MB RAM, 1.2MB floppy disk drive, 2 serial and 1 parallel port, DOS 3.3
	5 half-height	8 half-height	8 half-height, 1 full-height	5 half-height	6 half-height	5 half-height	5 half-height
	□	□	■	OS/2 1.1 ($325)	□	OS/2 1.1 ($352)	OS/2 1.1 ($340)
	20, 40, 80, 120, 150, 156	40, 100	60, 150, 330, 768	90, 150, 320	150	80, 140, 320	150, 300
	One 32-bit, five 16-bit, two 8-bit	One 32-bit, seven 16-bit	Three 32-bit, five 16-bit, one 8-bit	Three 32-bit, three 16-bit, one 8-bit	Ten 16-bit, two 8-bit	Two 32-bit, five 16-bit, one 8-bit	Eight 16-bit, three 8-bit
	3	6	4	4	3	4	5
	220	220	250	220	240	220	220
	72	90	72	110	72	82	90

	$5,455	$8,937	$9,240	$10,039	$9,009	$12,466	$11,173 (150MB hard disk, 150MB tape backup)
	(150MB hard disk, 80387-25)	(105MB hard disk)	(150MB hard disk)	(150MB hard disk)	(150MB hard disk)	(2MB RAM, 148MB hard disk)	
	Not especially priced	Unavailable	$550	Unavailable	Unavailable	$1,895	Unavailable

	$6,750	$9,052	$10,415	$9,239	$9,009	$12,466	$11,173
	4MB RAM, 1.2MB floppy disk drive, 1.44MB floppy disk drive, NEC MultiSync 3D monitor, 80387-25, DOS 4.01	4MB RAM, 105MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, DOS 4.01	4MB RAM, 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, VGA monitor, 80387-25, DOS 4.01	2MB RAM, 1.2MB floppy disk, 12MB hard disk, VGA monitor, DOS 3.3	4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA monitor, DOS 3.3	4MB RAM, 148MB hard disk, 1.44MB floppy disk drive, VGA monitor, DOS 3.3	4MB RAM, 150MB hard disk, 150MB tape backup, 1.2MB floppy disk drive, VGA monitor, DOS 3.3

CONTINUES

25-MHz 386-BASED PCs: SUMMARY OF FEATURES

(Products listed in ascending price order)

	SAM 3001/386-25	ACMA 386/25 Business System	CSS Select 386-25	Micro Labs 386/25	Proteus 386-MX25	Tandon 386/25
TESTED CONFIGURATION						
Microprocessor clock speed (MHz)	8/25	8/8/25	8/25	8/25	8/25	8/25
Wait states	0	0	0	0	0	0
Bus clock speeds (MHz)	8	8.33	8	8.33	8	8.33
Disk controller manufacturer and type	DTC (MFM/RLL)	Western Digital (SCSI)	Adaptec (ESDI)	Western Digital (ESDI)	Western Digital (ESDI)	Adaptec (MFM/RLL)
Number of drives handled by controller	4	4	4	4	4	4
BIOS version and date	Phoenix BIOS Plus, Version 1.10 00 (January 1988)	Phoenix BIOS Plus, Version 1.10 10 (January 1988)	Award BIOS, Version 3.03 NFS (September 1987)	AMI BIOS, Version DAMI 3067 (September 1988)	AMI BIOS, Version 386-C&T (December 1988)	Tandon BIOS, Version 305-3.15 (May 1989)
System board manufacturer	FlashCom	Micronics	CSS	AMI	Proteus	Micronics
386 chip set manufacturer	Chips and Technologies	Chips and Technologies	VLSI	Chips and Technologies	Chips and Technologies	Chips and Technologies
MEMORY SPECIFICATIONS						
Memory chip type	1Mb	1Mb	1Mb	1Mb	1Mb	256Kb, 1Mb
Chip packaging	SIMM	DIP	DIP	DIP	DIP	DIP
Memory chip speed (nanoseconds)	80	80	100	80	100	80
RAM chips	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM
Interleaved memory	❑	■	■	❑	❑	■
Shadow RAM	❑	■	❑	■	■	❑
Shadowing can be turned off	N/A	■	N/A	■	■	N/A
Disk cache software	❑	■	❑	❑	❑	❑
Maximum 32-bit RAM	16MB	16MB	16MB	16MB	16MB	16MB
Maximum RAM on motherboard	8MB	8MB	8MB	4MB	4MB	N/A
Maximum total system RAM	16MB	16MB	16MB	16MB	16MB	16MB
PROCESSOR RAM CACHE						
Cache size:						
Minimum	64K	64K	32K	64K	32K	64K
Maximum	64K	64K	64K	64K	32K	64K
Installed	64K	64K	64K	64K	32K	64K
Cache memory speed (nanoseconds)	35	35	20	25	25	35
Cache controller	Discrete logic	Intel 82385	Intel 82385	Discrete logic	Intel 82385	Intel 82385
OTHER						
Warranty	1 year	2 years	1 year	1 year	15 months on-site	1 year
FCC certification class	B	B	B (pending)	B	B (pending)	B
Password security	❑	❑	❑	❑	❑	■

■—Yes   ❑—No

N/A—Not applicable: the product does not have this feature.

	Amax PC/386-25	Mitac MPC-4000F	PC Craft 3600/25C	AST Premium 386-25	Tele 386-25	Unisys PW² 800-25A	WYSEsystem 386
	6/8/25	16/20/25	8/25	4.77/8/25	16/25	8/25	8/25
	0	0	0	8	0	0	0
	8.33	8.33	8	8	8	8	8
	Future Domain (SCSI)	Connor Peripherals (ST-506/MFM)	Western Digital (ESDI)	Western Digital (ESDI)	Western Digital (ESDI)	Adaptec (SCSI)	Western Digital (ESDI)
	4	4	4	5	4	4	4
	Phoenix BIOS Plus, Version 1.10 10 (January 1988)	Phoenix BIOS, Version 3.07 (June 1989)	Award BIOS, Version N:Y.3.04e (June 1988)	AST BIOS, Version 1.20 (March 1989)	Televideo BIOS, Version 1.03 (July 1989)	Phoenix BIOS Plus, Version 1.10 04.C1A (January 1988)	Phoenix BIOS, Version 3.06 (February 1989)
	Micronics	Mitac	Mylex	AST	Televideo	Intel	Wyse
	Chips and Technologies	Chips and Technologies	Chips and Technologies	AST	Chips and Technologies	Intel	Wyse
	1Mb	1Mb	1Mb	1Mb	1Mb	256Kb, 1Mb	1Mb
	DIP	SIP	SIMM	SIMM	SIMM	SIMM	SIMM
	85	80	80	100	100	80	100
	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM	DRAM
	■	■	■	■	□	■	■
	■	■	■	■	□	■	■
	■	■	■	■	□	■	■
	□	□	■	■	□	□	□
	16MB	24MB	32MB	36MB	16MB	18MB	16MB
	N/A	8MB	N/A	4MB	N/A	2MB	N/A
	16MB	24MB	32MB	36MB		18MB	16MB
	32K	32K	64K	32K	32K	64K	64K
	64K	32K	128K	32K	32K	64K	64K
	64K	32K	64K	32K	32K	64K	64K
	35	30	25	25	25	25	25
	Intel 82385	Intel 82385	Discrete logic	Intel 82385	Austek 38152	Discrete logic	Wyse
	1 year	1 year on-site	1 year; 4 months labor	1 year	1 year on-site	1 year	1 year
	B (pending)	B (pending)	B (pending)	B	B	B	B
	□	■	□	■	□	□	□
							ENDS
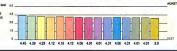
BENCHMARK TESTS: 25-MHz 386-BASED PCs

Pan United's Micro Labs 386/25 captured a first-place finish on our Conventional Memory test and on two video benchmark tests (including one tied score). It also performed well on the processor tests but was surpassed by the CSS Select 386/25, which runs its 25-MHz processor st 26.6 MHz.

PROCESSOR AND MEMORY BENCHMARK TESTS

80386 Instruction Mix
Elapsed Time (seconds)

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

2.47 2.45 2.32 2.31 2.31 2.27 2.25 2.23 2.23 2.23 2.22 2.22 2.22 2.21 2.19 2.16

Floating-Point Calculation Without Coprocessor
Elapsed Time (seconds)

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

4.45 4.29 4.23 4.12 4.16 4.12 4.06 4.01 4.01 4.01 4.06 4.01 4.01 4.01 4.01 3.9
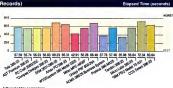
Conventional Memory
Elapsed Time (seconds)

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

0.39 0.47 0.35 0.47 0.36 0.41 0.38 0.36 0.38 0.36 0.38 0.33 0.33 0.33 0.33 0.41

DISK BENCHMARK TESTS

DOS File Access (Small Records)
Elapsed Time (seconds)

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

57.50 55.74 56.23 56.93 69.23 65.31 42.91 56.26 68.46 37.78 57.46 35.08 56.84 72.34 63.64

Tele 386/25
AST Premium 386/25
PC Crat 3SN/25C
*Compex Designs 386/25
SAM 3001/138/25
Areal PC386/25
WYSEsystem 356 Model 3255
Micro Mini PMF 90/25A
Mylex MF 90/25A
ACMA 386/25 Business System
Proteus 386/sk/25
Tension Labs 386/25
Unite Labs 386/25
*IBM PS/I Model 70 A21
CSS Select 386-25
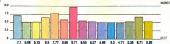
* Reported for comparison.

BENCHMARK TESTS: 25-MHz 386-BASED PCs
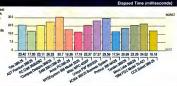
DOS File Access (Large Records)

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

Elapsed Time (seconds)

WORST

BEST

| 7.1 | 5.08 | 5.13 | 6.5 | 5.77 | 5.86 | 9.71 | 5.55 | 5.27 | 4.99 | 5.0 | 4.71 | 5.28 | 6.71 | 5.29 |

BIOS Disk Seek

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

Elapsed Time (milliseconds)

WORST

BEST

| 23.42 | 17.93 | 23.11 | 26.36 | 30.7 | 16.9 | 17.19 | 23.37 | 27.37 | 29.59 | 17.54 | 20.69 | 23.29 | 24.52 | 18.16 |

Tele 386-25 / AST Premium 386/25 / PC Craft 386/25SC / *Compaq Deskpro 386/25 / SAM 300/1D5/-25 / Amax PC385-25 / Ultima 386/25SF / WYSEsystem 386 Model 3225 / Umax MPC-425SF / Proteus 386 BXVISA Business System / ACMA 386/25 Business System / Proteus 386-M/25 / Tandon 386/25 / *IBM PS/2 Model 70-A21 / CCS Select 386/25

PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

PC Labs tested thirteen computers in the 25-MHz 80386 class and normalized them against the popular Compaq Deskpro 386/25. Test results for the IBM PS/2 Model 70-A21 are also reported for comparison.

You'll have to look closely at our processor and memory tests to see any difference among the contenders in this lineup. In fact, on the 80386 Instruction Mix test, the leader—the CCS Select 386-25—showed only about 13 percent off the score of the slowest computer, the Tele 386-25. You might notice a difference in some processor-intensive tasks, but at this clock speed, flying is flying.

The Floating-Point Calculation test had very similar results, with the same two computers (CCS Select 386-25 and Tele 386-25) in first and last place, respectively. This margin is attributable to the faster overall system speed of the CSS unit, which pushes its Intel processor to run at 26.6 MHz.

The fastest performer in our roundup on the Conventional Memory test, Port United's Micro Labs 386/25, tied the IBM PS/2 Model 70-A21. The Micro Labs 386/25 comes with 80-nanosecond DRAM chips, plus a 64K RAM cache with a proprietary cache controller rated at 25 ns. Note that each of the computers has an on-board RAM cache of at least 32K, evidence of manufacturer response to buyers' demands for faster and better memory.

The fastest scores on the DOS File Access test for both small and large records were achieved by the Tandon 386/25. A faster bus speed and a 330MB Maxtor drive contribute to this success story. The 25-MHz Tandon 386 Model 3225 captured first place on the BIOS Disk Seek test: a fast ESDI interface is used on the 150MB CDC drive we tested. I/O bottlenecks can become a noticeable problem, especially on this class of computers, but the units tested here reflect the current solutions: faster interfaces and on-board caching.

Relative Times
(Compaq Deskpro 386/25 = 100)

DOS File Access (Large Records) / BIOS Disk Seek / DOS File Access (Small Records) / Floating-Point Calculation Without Coprocessor / Conventional Memory / 80386 Instruction Mix

*Reported for comparison.

CONTINUES

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BENCHMARK TESTS: 25-MHz 386-BASED PCs

VIDEO BENCHMARK TESTS

Direct to Screen

Elapsed Time (seconds)

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.

WORST

BEST

2.8 2.14 2.85 1.96 5.44 5.08 5.09 4.61 4.61 2.58 3.74 4.72 2.66 6.53 3.02

Video BIOS Routine with Scrolling

Elapsed Time (seconds)
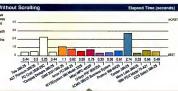
The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

WORST

BEST

1.59 1.44 3.13 3.46 1.32 3.4 2.58 2.91 2.91 1.43 1.43 2.25 4.78 1.32 3.4 3.02

Video BIOS Routine Without Scrolling

Elapsed Time (seconds)

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

WORST

BEST

0.44 0.51 2.25 0.44 1.1 0.82 0.05 0.76 0.33 0.38 0.61 2.74 0.33 0.66 0.49

Tele 386/25
AST Premium 386/25
PC Craft 3300/25C
*Compaq Deskpro 386/25
SAM 3201/25
WYSEpro 386 Model 3225
Mitac 386/20000P
Arirox PW 8300/25A
ACMA 386/25 Business System
Protecs 386/25
Tandon 386/25
*IBM PS/2 Model 70-A21
CCS Select 386-25
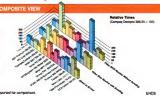
VIDEO BENCHMARK TESTS: COMPOSITE VIEW

Relative Times
(Compaq Deskpro 386/25 = 100)

Not all VGA cards are created equal, as we see from PC Labs' video benchmark tests, where the slowest machines took anywhere from about three to eight times as long as the fastest. 8-bit cards will really slow you down here, as demonstrated by the Tandon 386/25.

Now to look at the winning end of the scale: On our Direct to Screen test, the Amax PC/386-25 with its 16-bit VGA card was surpassed only by our reference standard, the Compaq Deskpro 386/25. The Micro Labs 386/25 also used 16-bit VGA cards, winning top honors both on Video BIOS with Scrolling and on Video BIOS Without Scrolling, where its score was tied by the Unisys PW* 800/25A.

* Reported for comparison.

ENDS

The Amax motherboard doesn't hold any memory itself: all memory is on cards, with a maximum of 8MB per card. Memory chips on the test machine were 85-nanosecond 1MB DIP chips. The Micronics board design uses both memory interleaving and shadow RAM for video and ROM BIOS, the latter two capable of being disabled by the user setup program. The Amax RAM cache has an Intel 82385 controller with 35-ns. static RAM chips.

Since Amax machines are sold by dealers or value-added resellers, (VARs); these form your first line of support. Amax machines come with a one-year parts and labor warranty; a second-year service contract is available for 15 percent of the original system purchase price.

Amax Engineering builds proficient machines with standard, quality components. While there may be nothing here to holler about because of especially fast speed or trickier-than-usual technology, simple competence should speak eloquently for itself.

AMERICAN MITAC CORP.
Mitac MPC-4000F
by Catherine D. Miller

American Mitac's 25-MHz 386 offering, the Mitac MPC-4000F, is housed in a modified tower case that is designed to sit either on your desk or on the floor. At 16.75 by 9 by 19 inches (HWD) when standing, it's shorter and wider than most tower systems but narrower and higher than standard AT-size desktops. However you look at it, with its five half-height and

one 3.5-inch drive bays, it's roomy.

The basic configuration of the Mitac MPC-4000F carries a list price of $5,195. You get 1MB of 80-nanosecond RAM in 256K SIMM packaging, a 30-ns. 32K static RAM cache controlled by the Intel 82385-25 cache controller, a 1.44MB 3.5-inch floppy disk drive, a 220-watt power supply, one parallel and two serial ports, a 101-key keyboard, and DOS 4.01.

The MPC-4000F's somewhat boxy-looking case has several special features. The back panel features a 25-pin parallel and two 9-pin serial ports, along with a keyboard connector. The front panel has another keyboard connector at its base and a row of indicator lights for power, hard disk access, and microprocessor speed, plus a well-protected power switch along the top. Four of the six drive bays are accessible from the front of the system, and Mitac includes its own 101-key keyboard with the PC.

Mitac builds its own system board, which lies along the right side of the unit. Two floppy disk drives can be controlled directly from the board, so the basic system doesn't include a disk controller card. The Chips and Technologies chipset supports the processor's functions, and an In-

tel 82385-25 cache controller handles 32K of 30-ns. static RAM. The board cannot accept more chips to make a larger cache. The Mitac MPC-4000F uses a Phoenix BIOS, which lets you choose if you want to shadow video and ROM BIOS in RAM. Microprocessor speeds are software switchable to 16, 20, or 25 MHz, yet the

bus always runs at 8.33 MHz.

Two sets of SIP sockets lie under the power supply. Each set holds four 256-kilobit or 1-megabit (Mb) SIP memory blocks for a maximum 8MB RAM on the motherboard. Although SIPs in the same set must be of the same chip size, you can use both 256-kilobit and 1Mb memory blocks together, each in its own set. The unit as tested used 80-ns. 1Mb chips to make four 1MB blocks, with the second and empty.

The Mitac MPC-4000F supports 24MB of 32-bit page-interleaved system RAM: 8MB on the motherboard and an additional 16MB on a 32-bit memory board. No DIP switches need to be set if the system's memory configuration is changed, but you must run the Setup program to set the extended memory size.

Our $9,052 evaluation unit included 4MB RAM, a 1.2MB 5.25-inch floppy disk drive, a 105MB hard disk and a ST-506/MFM controller card from Connor Peripherals, the Paradise 16-bit PVGA Plus VGA card, and the Tatung VGA monitor.

Performance on PC Labs benchmark tests was strong for this class of machine on processor, memory, and video tests. Showings on the disk benchmark tests were lower but still competitive.

The manual accompanying the Mitac MPC-4000F does an excellent job of showing how the system can be expanded.

It also guides you through all the steps necessary to get the system up and going. The standard suite of utilities and setup included with the Phoenix BIOS are described in an appendix. Although the manual is written simply enough for beginners to understand, it also includes solid technical information about the system.

American Mitac uses several distribution channels to get its products to market. Major distributors such as Micro American, dealers, and value-added resellers (VARs) carry the Mitac line of computers. While the company offers a 1-year parts and labor warranty, on-site and extended warranties are available through TRW.

Although it may be more expensive than some of the other systems reviewed here, the Mitac MPC-4000F is a well-constructed and well-integrated system offering plenty of room for expansion. Either as a desktop or a floor-standing tower, the Mitac MPC-4000F is a flexible system that deserves a closer look.

AST RESEARCH INC.
AST Premium 386/25
by Catherine D. Miller

AST Research has designed the AST Premium 386/25 with an eye toward the future. Based on a modular design, the CPU, some RAM, the cache controller, cache memory, and sockets for Weitek 3167 and Intel 80387-25 coprocessors reside on a 32-bit processor card. The system board, containing the ROM BIOS, I/O ports, and seven expansion slots, supports AST's i486 upgrade card called the FASTboard 486/25. This means you can buy a 386 today and upgrade to a 486 tomorrow without losing your entire investment.

Housed in a 6.25- by 19.25- by 16.5-inch desktop case, the AST Premium 386/25 comes standard with 2MB of 100-nanosecond RAM in SIMM packaging, a 25-ns. 32K static RAM cache controlled by the Intel 82385 chip, a 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, a 220-watt power supply, a 101-key keyboard, DOS 3.3, GW-BASIC, and AST utilities for $5,695. The system board has three 32-bit slots (one of which is occupied by the processor card), three 16-bit slots, and one 8-bit slot.

Three of the system's five half-height drive bays are accessible from the front. The front panel includes a reset button and

indicator lights for microprocessor speed and hard disk access. The microprocessor speed is software switchable from 25 MHz to 8 and 4.77 MHz, and the expansion bus runs at 8 MHz.

A floppy disk drive controller, built into the system board, handles three floppy disk drives. Although the basic system has neither hard disk nor hard disk controller,

an AT adapter interface on the system board supports hard disks with AT-embedded controllers.

The AST Premium 386/25 supports a maximum of 36MB 32-bit RAM, with the CPU card holding only 4MB RAM. Additional memory expansion cards, each with a 16MB RAM capacity, are available and can be installed in the two remaining 32-bit slots to bring the total system memory up to 36MB. The list price for one of these

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cards with 1MB of RAM is $899.

The AST Premium 386/25 is unique while maintaining complete compatibility with current standards. Many components, including the system board, BIOS, processor card, and keyboard, are designed by AST. Engineered around AST's AT-compatible bus architecture, three expansion slots—two 32-bit and one 16-bit—have extra pins to accept boards created for the SMARTslots. AST's SMARTslot architecture was an attempt to share some of the processor's work with processors on other boards. However, at this point, no SMARTslot boards have been planned by AST or announced by third-party vendors, and AST plans to follow the EISA multimaster bus standard rather than attempting to create a standard of its own.

Although you might expect to see an increase in performance due to the utilization of this arbitrated multimaster bus, quite the opposite turned out to be the case. While competitive, the AST Premium 386/25's performance times on PC Labs processor and memory benchmark tests were often slower than those of most 25-MHz systems we tested here, finishing last in the

25-MHz 386s

AST Premium 386/25
With its CPU on a card, the AST Premium 386/25 is ready for AST's FASTboard 486/25, making upgrades easy. The unit as tested has 4MB RAM, 150MB hard disk, a 1.2MB floppy disk drive, VGA monitor, and DOS for $10,039.

Conventional Memory test.

The AST keyboard is the 101-key variety, with the 12 function keys arrayed across the top. The $9,239 review unit also included the AST VGA Plus 16-bit VGA card and monitor, Western Digital's ESDI controller supporting two hard disks, and a CDC full-height 150MB hard disk drive. The performance times of the AST evaluation unit on our disk and video benchmark tests were better than those of most of the 25-MHz 386 units reviewed in this article.

AST utility software grants you infinite control over the way your system is set up. Other programs included in the utility software are disk caching, expanded memory manager (supporting EMS 4.0), print spooler, and RAMdisk programs. The manuals accompanying the AST Premium 386/25 are well written and well organized. The system manual clearly describes the technical specifications of the system, as well as how to configure it for your needs. The AST Utility Software manual describes what the various AST utilities do and how to use them.

AST relies on a six-spoke distribution network. Its machines are sold through major chains, independent VARs and through

Application Menu—Just point 'n shoot to run any application or commonly used procedure. MIS managers can easily create customized user environments.

Split Windows—Simultaneously view, compare and manipulate two separate directories or drives, and quickly locate files.

AutoView—Save time and guess-work by scrolling through file contents from the directory or file window.

VADs, OEMs, major distributors, international distributors and governmental sales. The company offers a one-year parts and labor warranty, with service available directly from AST even if you buy your system through another distribution channel.

The AST Premium 386/25 distinguishes itself as a reasonable performer in this class of machine. Its fine craftsmanship and many extras make the AST Premium a unified system rather than just a collection of high-quality parts.

CSS LABORATORIES INC.
CSS Select 386-25
by Bruce Brown

The CSS Laboratories' 25-MHz machine breaks the rules, but just by a little. The system clock crystal in this otherwise standard-looking box is clearly marked as 53.2160 MHz. Since the system speed is attained by dividing the crystal speed in half, that means that the CSS 386/25 isn't a 25-MHz machine at all, but rather a 26.6-MHz machine. Many argue that pushing a crystal beyond the processor manufacturer's specification is a good way to get faster performance at a slight price, while others stipulate that any crystal speed over specifications increases the possibility of motherboard component breakdown over time. Pushing the processor an extra 1.6 MHz, less than 10 percent, doesn't seem like much of a threat, but it does account for the CSS's slight performance edge on the processor-determined benchmark speed tests.

CSS Laboratories is an Irvine, California company that designs its own mother-

boards. This one is called the *CSS Mother Superior 386/25-Cache*. The base unit lists for $2,800 and includes 1MB RAM, a 1.2MB floppy disk drive, plus two serial and one parallel port. *PC Magazine*'s standard configuration machine with 4MB RAM, a 106MB hard disk, VGA controller, and NEC Multisync 2A monitor costs $5,500. CSS prefers to unbundle DOS and math processors, specifying the prices separately at $90 for DOS 3.3 and an 80387-25 coprocessor at $575. According to CSS, the company doesn't sell DOS 4.01 because most of their buyers (they sell only to dealers and VARs) feel that DOS 4.01 has too many bugs at this time. If you want DOS 4.01, you'll have to get it separately from your dealer.

The test unit in the roundup is by 21.25- by 16.5-inch AT-style case lists for $5,700, including 4MB RAM, an 89MB ESDI hard disk, a 16-bit VGA card and an 80387-25 coprocessor but no monitor. The front of the case has keylock and reset buttons, as well as lights for power on, hard disk access, and turbo mode. Also included is a Honeywell keyboard with a minimal 72-inch cable.

Due most likely to the slightly faster crystal, the CSS machine was slightly faster on the 80386 Instruction Mix and Floating-Point benchmark tests. The rest of the PC Labs test results for the Select 386-25 were within the normal range for 25-MHz

CSS Select 386-25
In its quest for speed, the $5,500 CSS Select 386-25 uses a faster crystal that yielded 26.5-MHz system performance, plus 30-ns. chips in its 32K cache. With 4MB RAM, 106MB hard disk, and VGA, it is the fastest machine in this roundup.

386 machines, with solid disk performance and reasonable video scores.

With CSS's own motherboard you get a discrete set of chips to control the processor and Award's 386 Modular BIOS. The system can run at either 8 or 25 MHz with the expansion bus running always at a straight 8 MHz. Additionally there are eight expansion slots: two 8-bit, four 16-bit, and two 32-bit.

The Select 386-25 can hold up to 8MB of DIP DRAM chips on the motherboard itself, with 100-nanosecond chips in the test unit. Extra memory on cards can increase memory to the system maximum of 16MB. RAM cache on the CSS board consists of 32K run by an Intel 82385 controller. The 20-ns. chips are the fastest we found in this roundup, and they certainly help system performance.

Inside the case, there is enough room for six half-height drives, three of which can have exposed fronts for removable media. The Select 386-25's 200-watt power supply is plenty sufficient for the number of drives and the amount of memory the system can hold.

CSS machines come with a one year parts and labor warranty, fulfilled by the dealer. At the time of testing, CSS was negotiating for an optional Intel on-site service contract, but the deal wasn't set, nor was pricing available at that time.

If your dealer sells CSS machines, consider whether you want the slight threat to reliability for the minor gain in speed. If you choose to be safe, the dealer should have no problem getting this machine with a 50.00-MHz crystal and keeping you nested within prescribed standards, although you will lose some performance.

HITECH INTERNATIONAL INC.
SAM 3001/386-25
by Bruce Brown

If you want a 25-MHz 386 machine at the lowest cost, don't need much support, and are willing to live with slight system aberrations, read on. HiTech International is looking for buyers who care about price more than anything else. If you fit the category, do they have a deal for you!

HiTech's SAM 3001 in its 25-MHz variety uses a little-known Flashcom motherboard with the more common Chips and Technologies 386 chip set and de facto standard Phoenix BIOS. The base unit, with 2MB of RAM, a 1.2MB floppy disk drive, 220-watt power supply, keyboard, and no software costs just $1,595. This system is in a vertical case that measures 24.5 by 7.5 by 17 inches (HWD) and holds six half-height drive bays all available for removable storage media devices.

If you want a more fully configured system, a SAM 3001 with 4MB of RAM, a 120MB hard drive, both 1.2 and 1.44MB floppy disk drives, Samsung VGA monitor, and DOS 4.01 costs $3,250. An Intel 80387-25 math coprocessor is available separately for only $495. The unit ships with a compact Nan Tan

SAM 3001/386-25
With limited support and potential system problems, there is only one reason to consider the SAM 3001/386-25 by HiTech: its amazing price. This PC is only $3,250 with 4MB RAM, a 120MB disk drive, VGA monitor, and DOS.

keyboard, 18 inches wide and just 6.75 inches deep, with a marginally acceptable 72-inch cable.

The VGA card used in the SAM 3001 machines is a DEI board manufactured by Trident; it didn't help much with video speeds on PC Labs benchmark testing, keeping the SAM 3001's scores in the lower part of the pack. The other scores were all acceptable for this class of computer.

The SAM 3001 purportedly works at both 8 and 25 MHz. We had no problems at 25 MHz (which, after all, is the speed

PC MAGAZINE

FACT FILE

SAM 3001/386-25
HiTech International Inc., 712 Charcot Ave., San Jose, CA 95131; (408) 435-8827.
List Price: With 2MB RAM, 1.2MB 5.25-inch floppy disk drive, tower case, $1,595; with 4MB RAM, 120MB hard disk, both 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, VGA monitor, DOS 4.01, $3,250. 80387-25 math coprocessor $495.
In Short: If you want to take the risk of low support and possible motherboard incompatibility for the cheapest price, look closely at the SAM 3001/386-25. If you need security, look elsewhere.

CIRCLE 548 ON READER SERVICE CARD

you buy this machine for) but with the system slowed to 8MHz it wasn't able to run programs or access data on the hard drive. I was able to get a directory reading but could do nothing else with the C: drive when running at 8 MHz. HiTech International is aware of this problem and says it's being worked on, promising no particular date.

The expansion bus runs at a straight 8 MHz whatever the processor speed. There is one 8-bit, five 16-bit, and one 32-bit slot, with the last reserved for memory expansion beyond the motherboard's 8MB limit. The SAM uses 80-nanosecond 1-megabit SIMM chips and has a 64K RAM cache with 35-ns. static RAM cache memory chips. The memory cache doesn't use a specific controller chip such as the Intel 82385 or the Austek; rather, cache control is handled by discrete logic chips on the motherboard. The SAM design does not use memory interleaving or RAM shadowing of video or ROM BIOS.

The SAM 3001 has reset and turbo buttons, plus a turbo light on the front of the case. Only the reset button works. Certainly HiTech is trying to save money by using

the same cases, but even with HiTech's good deals customers spend four-digit amounts and should get functional controls.

HiTech International sells all of their systems directly, the emphasis being on price. There is a one year warranty on the system but only 90 days on hard disk drives. HiTech uses Seagate drives, and according to HiTech Seagate charges a $35 service fee for warranty work. HiTech also doesn't pay to ship warranty-repaired systems back to you: you pay both ways.

The HiTech SAM 3001/386-25 is a functional 25-MHz machine at a rock-bottom price. If little support, a less-than-comprehensive warranty, and a nonfunctional turbo switch and light don't bother you, then this machine may be just the deal you're looking for. If you want hand-holding and a dealer's gentle support, you probably didn't read this far anyway.

PAN UNITED CORP.
Micro Labs 386/25
by Bruce Brown

Pan United's Micro Labs 386/25 is a straight, good deal in a mail-order 25-MHz 80386 personal computer. Of course you want more details than that, but the first take on this machine is that it's a solid box with standard components sold at a reasonable price by a mail-order company that's been selling PC/AT/386 clones for several years.

The Micro Labs 386/25 comes in a desktop case that measures 5 by 21 by 16.75 inches (HWD). It includes an AMI motherboard, Chips and Technologies 386 chip set, and AMI BIOS. The base unit, for $2,995, includes 1MB RAM with a 64K cache, a 1.2MB 5.25-inch floppy disk drive, a 40MB 28-millisecond hard disk, one parallel and one serial port.

PC Magazine's standard test configuration, with 4MB RAM, 120MB hard disk, a VGA monitor and DOS, costs $4,600. Pan United actually prices DOS separately, selling DOS 4.01 as a $95 option. The company also sells an Intel 80387-25 math coprocessor for $575. The top system, with a 145MB Micropolis ESDI hard disk, a Video Seven Fast Write 16-bit VGA card, and Tatung VGA monitor (but no DOS) lists for $5,495.

Pan United's performance on the PC Labs benchmark tests showed better-than-average video performance overall. Video performance was arguably the best in the roundup; disk performance was solid; and the processor scores put the Micro Labs 386/25 in second place behind the CSS Selecet pushed to 26.6 MHz.

A CLOSER LOOK
The Micro Labs 386/25 runs at either 8 MHz or 25 MHz. The turbo light on the front of the system unit works, though the turbo button doesn't. You can set system speed via the keyboard with a Ctrl-Alt-Plus or - Minus key combination. The expansion bus runs at 8 MHz when the computer itself is at 8 MHz or at 8.33 MHz when the system is running at full tilt at 25 MHz. There are 8 slots in all: six 16-bit slots, one 8-bit slot, and one 32-bit slot.

The system board holds a maximum 4MB RAM. The as-tested unit came with 80-nanosecond DIP chips. Other memory, up to the 32-bit system maximum of 16MB, has to go on a memory card. The RAM cache uses discrete logic chips to run the standard 64K of 25-ns. static RAM cache memory chips.

The Micro Labs' case can hold five half-height drives, three of which accept removable media. The standard 200-watt power supply has four power leads, so if you plan to use five separate drives, you need to get a power splitter—a minor aggravation. The front of the case has a reset switch and a keylock in addition to the nonfunctional turbo button.

The standard keyboard is a Chicony model that measures 19.25 inches wide and 8.25 inches deep. This keyboard has a clicky feel and an 80-inch cable that atta-

ches to the right rear of the keyboard. The 101-key design has a large Enter key and small backslash and backspace keys.

Pan United sells through dealers and by mail-order, with about half of their sales through each. To augment the one year parts and labor warranty, the company uses mirror shipping—the standard practice among mail-order vendors, in which the vendor pays to ship an in-warranty repaired machine back to you in the same manner that you shipped it in for service. Pan United also offers a 30-day moneyback guarantee with no restocking fee.

No surprises, no incredible thrills or frills: Pan United's Micro Labs 386/25 is a solid deal in a mail-order machine. Sounds good to me.

PC CRAFT INC.
PC Craft 3500/25C
by Bruce Brown

If you're looking for a 25-MHz computer to stuff full of drives, ports, and memory, look no further. The PC Craft 3500/25C is pricey, but it can take up to 32MB of memory and has space for eight half-height and one full-height drive. The system comes in

Micro Labs 386/25
Pan United's Micro Labs 386/25 offers solid mail-order value, quality component parts, and reasonable support at a fair price. A system with 4MB, 120MB hard disk, VGA monitor, DOS, and a 30-day guarantee is $4,695.

a spacious vertical case with top-exiting cables and a locking system that lets you set this baby up to run undisturbed by anyone, including busybodies who might accidentally try to reboot the machine when nobody's looking.

The 3500/25C tower unit measures a full 24.5 by 9 by 23 inches. The base unit, starting with 4MB of RAM and a 64K cache, costs $5,569, a sizable chunk of change. But for a file server dedicated to network applications, tucked neatly away in a back room with your company's applications and data, case size and price aren't an issue.

Although the as-tested unit has 4MB RAM, a 150MB hard disk, both 1.44 and 1.2MB floppy disk drives, VGA, a Maxi-Switch 101-key keyboard, and an 80387-25 math chip for a total suggested list of $10,415, it is not a speed demon. The video speeds on PC Labs benchmark tests were slow, but otherwise the remaining scores were all in the normal range for a 25-MHz 386.

ON THE MOTHERBOARD

The PC Craft's expansion bus runs at a constant 8 MHz, with system speed user-

PC Craft 3500/25C
At the high end of the price spectrum and having what it takes to be a file server, the PC Craft 3500/25C packs 4MB RAM, a 150MB hard disk, two floppy disk drives, VGA, an 80387-25 coprocessor, and DOS into its spacious case for $10,415.

selectable at 8 or 25 MHz. Inside there are five 16-bit slots, three 32-bit slots, and one 8-bit slot. The standard power supply is a 250-watt unit with two fans and an unusual heat sensor that speeds up the fans as the temperature inside the system unit increases. For a box with the size and capacity of the PC Craft the larger power supply and extra cooling make sense and are obviously one reason why the computer costs a bit more.

The system uses a Mylex motherboard with a Chips and Technologies 386 chip set and Award 386 modular BIOS. Fully loaded, the PC Craft can handle 32MB of 32-bit RAM. All memory fits on memory cards in SIMM slots; none on the motherboard. The memory on the test machine

was rated at 80 nanoseconds, with 25-ns. static RAM chips on the standard 64K RAM cache controlled by discrete circuitry. This motherboard uses memory interleaving as well as RAM shadowing of both video and ROM BIOS (both of which you can disable).

On the outside, the front panel has indicator lights for disk access, turbo speed, power on, and keyboard disabling. Behind the front panel, which really swings out like a door, is a rocker switch that disables the keyboard to protect the system against accident or malicious rebooting, or some such friendly touch your network doesn't need.

The PC Craft 3500/25C is sold only through value-added resellers (VARs) and

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POTENT MEDICINE, STRONG SIDE EFFECTS:
The Pros and Cons of 386 Performance Enhancements

by Winn L. Rosch

Coaxing the most performance possible from a computer requires more than just cranking up the clock crystal to 33 MHz and letting the 386 microprocessor run wild. PC makers must brew together an amalgam of technologies to match the speed abilities of system components. Like steroids, these electronic miracle drugs can have powerful results—and equally profound side effects. Here's a guide to the most effective power prescriptions:

Dynamic and static RAM Most memory chips used in today's PCs are classified as *dynamic random-access memory*, or DRAM. They store data as tiny charges in memory cells. Because these charges drain away, DRAM must be refreshed constantly, which imposes delays between accesses so that the charges can build up and stabilize (typically from 60 to 150 nanoseconds). Since *static RAM* chips do not need to be refreshed, they can be accessed as quickly as their circuits can handle the signals: every 15, 25, or 35 nanoseconds. While SRAM is faster, it's prohibitively expensive and usually reserved for small memory caches where speed is more important than cost.

(Reducing) wait states The easiest way to match a fast, 33-MHz microprocessor to slower DRAM chips is by adding wait states—that is, periods when the microprocessor stops dead to

let the slower RAM chips catch up. Wait states reduce memory cost but impose a big penalty in performance: an 80386 memory access requires two clock cycles (one to specify an address, one to read or write it), and a wait state stretches that to three, slowing the system by one-third. Some operations, including cache misses and frequent read/write operations, may require 20 or more wait states.

Interleaved memory The cheapest technique for minimizing wait states is to interleave memory. Interleaving divides the total RAM of a system into two or two banks that are accessed alternately. When one bank is being refreshed, the other can be accessed without wait states. While interleaving can cut wait states by 50 to 75 percent, it also makes memory expansion more difficult because two or two identical banks of additional memory must be added at a time.

Paged memory Special paged

memory chips are designed to allow back-to-back accesses without wait states within blocks of memory addresses called pages. Paged memory can cut wait states by 80 percent. Tradeoffs: accesses to memory outside the last-used page impose wait states, and more importantly, paged memory chips are more expensive and can be difficult to find when you want to add memory to your system.

Processor RAM caching A small block (typically 32 to 128K) of fast SRAM is connected to the processor and uses a special cache controller, such as Intel's 82385 chip, to move data from slow main memory into the cache, anticipating what information the processor will request next. When the controller is right, accesses to the cache impose no wait states. The penalty for caching is more complicated circuitry, added expense for controller and SRAM, and additional wait states on cache misses.

Shadow RAM The slowest memory is ROM, yet it holds the code that controls your PC's video display, hard disk, and keyboard. Copying the ROM BIOS code into faster RAM and using the 80386's memory-mapping ability to fool programs into using the RAM copy speeds up these I/O functions. Called shadow RAM because the code in RAM follows the ROM code, the tradeoff of this technique is its appropri-

PC Craft's direct sales force. The standard warranty is for one-year parts and labor coverage and includes a four-month on-site service contract for the crucial system break-in period. Extended on-site and depot (you take it to a service center) service contracts are available for 12 percent and 8 percent of the system list price per year of the contract.

The PC Craft unit is the most capacious of those reviewed in this issue. Truly this machine isn't intended for single users unless they happen to be very, very busy. It's designed for use as a dedicated DOS file server or for Unix applications. With its many nice touches for heavy use, the PC Craft computer is a great choice for multiuser applications.

PROTEUS TECHNOLOGY CORP.
Proteus 386-MX25
by Bruce Brown

You may not have heard of Proteus Technology yet, but if they keep on doing what they've done so far, you will be. The Proteus 386 25-MHz PC reviewed here offers a good combination of components, performance, and vendor support, including 15 months of on-site service for machines located at either business or home locations. Proteus positions itself as a service-oriented company, a good move in an industry where users often feel abandoned after they buy a machine.

The Proteus 386-MX25 features a straightforward 386 design using Proteus's own motherboard, the Chips and Technologies 386 chips set, and an AMI BIOS. The base unit, priced at $2,995, includes 1MB RAM with 32K of 25-nanosecond cache memory and an Intel 82385 cache controller, either a 1.2- or 1.44MB floppy disk drive, two serial and two parallel ports, diagnostic and utility software.

PC Magazine's standard configuration system with 4MB of RAM, a 150MB hard disk, 16-bit VGA card, Mitsubishi Diamond Scan monitor, and DOS 4.01 lists for $5,783. The as-tested unit has 2MB RAM, a 150MB drive, an 8-bit VGA card

ation of up to 384K of RAM that certain applications, including *Lotus 1-2-3*, Release 3.0, require to run properly.

Extended and expanded memory 80386 systems can address memory beyond their first megabyte as extended or, with driver software, as expanded (EMS or LIM 4.0) memory. The 80386 operates optimally when using extended memory. If EMS memory is simulated from extended memory using software such as Quarterdeck's *QEMM-386*, expanded memory performance nearly equals that of extended memory. But using an EMS board in an expansion slot or an old EMS driver designed for 80286 computers will impose severe speed penalties.

Bus speed While 80386 machines now run at 33 MHz, most have expansion buses limited to 16-bit width and 8-MHz operation. The low speed and narrow width lead to at least an eightfold slowdown for any information traversing the expansion bus, including video and hard disk data. Speeding up the bus trims the slowdown but sacrifices compatibility, many expansion boards fail at higher speeds. The new 32-bit proprietary buses—for instance, Micro Channel and EISA—will require new expansion boards to take advantage of the wider data path.

16-bit integrated video Most video adapters still use 8-bit interfaces, slowing displays to one-fourth that of

the 32-bit 80386. Widening the interface to 16 bits can double the speed of screen updates. Expansion bus overhead imposes additional performance limits, so integrating the display circuitry onto the system board gives additional speed increases. Drawbacks: integrated video circuitry frustrates upgrade possibilities because you must bypass system board video circuitry to

use it; hence, you will end up paying for video that you are not using.

Hardware disk caching Finding data on a hard disk is significantly slower than locating it in memory because of mechanical delays imposed by the disk drive. A hardware disk cache adds fast memory to the disk controller to store the data to be needed next by the computer, which then can be retrieved at memory rather than disk speed. While hardware caching is the best way to speed up any disk, it's also among the most expensive, adding nearly $1,000 to the price of the disk controller. Some

software applications also suffer compatibility problems with the disk caching controller.

Software disk caching By using your system's existing RAM as a cache with a software disk caching program, you can speed up your hard disk performance. Relatively inexpensive and quite effective, software caches suffer from their strength. They sap both memory and power from their hosts: RAM used for caching can't be used by programs, and cache overhead slows system processing.

Math coprocessor The 80386 chip is not optimized for mathematics. A math coprocessor (sometimes called a floating-point or numeric coprocessor) can significantly speed up programs requiring heavy-duty math, such as statistical, engineering, and graphics software. But math coprocessors are expensive ($500 to $600 for a 33-MHz 80387), and they work only with software specifically written to take advantage of them in machines designed to accommodate them. Another drawback is that the Intel 80387 and the Weitek 3167 are neither code- nor pin-compatible with one another. Moreover, a math coprocessor won't speed up normal business math (addition and subtraction) at all.

Winn L. Rosch is a contributing editor of PC Magazine.

MHz. Up to 4MB RAM fits on the motherboard, with an additional 12MB on an optional memory card in the 32-bit slot. The DIP-style memory chips are rated at 100 ns. Proteus's motherboard doesn't use memory interleaving but allows you to shadow RAM for both video and ROM BIOS if you choose.

The Proteus 386-MX25 scored well on our benchmark tests, with strong results on the processor and memory tests. The other PC Labs test results were within the normal range for 25-MHz 386 machines.

In addition to the numerical keylock, reset button, and power, turbo, and hard disk drive access lights, there are also a speaker on/off switch and a red, two-character LED status and error-condition display. The Proteus keyboard is a private label enhanced unit with a 72-inch cable.

Proteus has several end-user-oriented policies, including a 30-day money-back guarantee, toll-free technical support, and the 15-month on-site service contract. Additional extended service contracts are available at the time of purchase. Adding in the solid 25-MHz performance, the Proteus 386-MX25 is an attractive machine that should appeal to both business and private users.

Proteus 386-MX25

Proteus combines 15-month on-site support, toll-free technical help, and extended service contracts with solid 386 performance to make its 386-MX25 a solid value. The system sells for $5,783 with 4MB RAM, a 150MB hard disk, a Mitsubishi VGA monitor, and 80387-25 coprocessor, and DOS.

and NEC MultiSync 3D monitor for a total price of $5,225 with DOS.

The system is a desktop unit measuring 6.5 by 21.25 by 16.5 inches with room for five half-height drives. Three drive bays are accessible at the front of the case. The 200-watt power supply is sufficient for five drives and can also handle the eight expansion slots—a complement of one 8-bit, six 16-bit, and one 32-bit slot, all of which run at 8 MHz.

The processor runs at either 8 or 25

TANDON CORP.
Tandon 386/25
by Bruce Brown

Tandon Corp. makes and sells computers that are most known for Tandon's drive technology: Tandon's Personal Data Pac system, which consists of removable hard disk drives in 30- and 40MB cartridges that ease data transport, security, and backup and are available in internal and external versions to work as main or ancillary storage for Tandon computer systems.

The Tandon 386/25 is a 25-MHz personal computer in a desktop configuration. The case measures 6.5 by 21.25 by 16.5 inches, a standard size for desktop AT-style machines. The base unit, with 1MB RAM, a 1.2MB 5.25-inch floppy disk drive, one serial port, one parallel port, MS-DOS 3.3, GW-BASIC, and *Microsoft Windows* 2.03 lists for $3,051, complete with a 101-key keyboard that's 19 inches long, 8.25 inches deep, and has an 80-inch cable.

The Model 386/25, configured with 5MB RAM and a 330MB Maxtor hard disk, 8-bit VGA video card and VGA monitor, costs $7,099. The as-tested unit is $5,955 with just 1MB of memory, the 330MB drive, VGA, an external In-PAC Receptacle and 30MB Personal Data Pac, plus the three software packages. Tandon doesn't sell math coprocessors; however their authorized dealers will be happy to sell you one.

The Tandon uses a Micronics mother-

Tandon 386/25

Tandon's 386/25 combines 25-MHz performance with its Personal Data Pac removable disk subsystem for fast and flexible performance. A 5MB RAM, 330MB hard disk, VGA system with DOS, and the Data Pac sells for $7,099.

board capable of running at either 8 or 25 MHz. In each case the expansion bus runs at 8.33 MHz, powering the two 8-bit, five 16-bit, and one 32-bit slot. The Micronics motherboard uses the Chips and Technologies 386 chip set and Tandon's own BIOS, which in the power-on sequence pauses to allow you to specify the boot drive.

One of the principal advantages of the Tandon Personal Data Pac system is that you can have different operating systems on your hard disk and on a Data Pac and then specify which one you want when you start the system. This kind of setup has many different possibilities for creative use; for example, running Unix on your hard disk but keeping DOS on a Personal Data Pac for your special DOS-only applications or files.

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The Tandon is no slouch, either. The 386/25 proved to be the third fastest of the 13 machines reviewed here on the PC Labs processor and memory benchmark tests. Video scores were poor due to an 8-bit card, so get a 16-bit adapter instead. Hard disk performance had first-place finishes in two of the three tests.

You can use either 256-kilobit or 1-megabit memory chips on the memory board, with a possible system total of 16MB on the board. No memory is installed on the motherboard itself. The chips installed on the test unit were rated at 80 nanoseconds. The Intel 82385 cache controller manages the 64K of 35-ns. cache memory chips, making the processor scores even more impressive since many of the other machines reviewed here opted for 25-ns. cache memory chips.

The basic system box is designed to hold five half-height drives, using a 190-watt power supply with four device leads. The 330MB Maxtor drive is a full-height device, as is the internal In-PAC Receptacle. The as-tested unit's external In-PAC Receptacle is attached by cable to a part inside the computer. The cable carries both the power and the drive controller commands for the Data Pac device.

The Tandon case is attractive with a recessed reset button and lights for power on, hard disk access, and to indicate either 8- or 25-MHz operation. The only unusual touch is a bright blue strip along the top-front edge of the computer that adds a little color to the case.

Tandon has a standard one-year parts and labor warranty but no provisions for

on-site service or extended warranties. Tandon's dealer network handles these needs.

The best thing about the Tandon 25-MHz 386 machine is the Personal Data Pac system. There are other types of removable, bootable storage media, such as Bernoulli cartridges, but the Tandon design, with new lower prices, is an attractive configuration for good data security, especially if you want to maintain more than one operating system on the same computer. Factor in fine 25-MHz 386 performance, and the Tandon 386/25 is an attractive machine.

TELEVIDEO SYSTEMS INC.

Tele 386-25

by Catherine D. Miller

Using a modular design, for its desktop-model Tele 386-25, TeleVideo Systems manages to cram 12 slots and six half-height drive bays in the 6- by 20.75- by 16.25-inch (HWD) case. Although four of the 12 slots are used for the CPU, memory, video, and controller cards, the remaining eight slots leave plenty of room for expansion. And the modular design

Tele 386-25
The Tele 386-25 features a backplane 12-slot design, with CPU and memory on separate cards and eight open slots for expansion. Configured with 4MB RAM, a 150MB hard disk, VGA, and DOS, TeleVideo's 25-MHz PC sells for $9,009.

makes the system easier to service if you should have problems.

Bearing a list price of $5,995, the basic configuration includes 4MB of 100-nanosecond SIMM-type DRAM; Austek's 38152-25 cache controller with a 25-ns. 32K static RAM cache; Western Digital's

> Despite unremarkable scores, the Tele 386-25 offers solid 25-MHz performance.

1007 5.25-inch floppy/hard disk controller card; a 1.2MB 5.25-inch floppy disk drive; a 240-watt power supply; one parallel and two serial ports; a solid Fujitsu 101-key keyboard and DOS 3.3. Our $9,009 evaluation unit added a 150MB ESDI hard disk from Micropolis, TeleVideo's own 16-bit VGA card based on the Trident TVGA 8800CS controller chip, and a Samsung VGA monitor.

WHAT'S OUTSIDE

Four of the six drive bays accept removable media. A reset button and indicator lights for power and hard disk access reside on the front panel. The back panel includes a 9-pin serial port and the keyboard connector. The power switch is located on the rear right side of the case.

Inside, starting at the left side of the machine, the 12-slot backplane runs along the back of the system, with the last four slots running into the first of two banks of drive bays. If you put storage devices in these bays, you'll reduce the length of these four slots so that they'll accept half-length cards only. Wisely, this is the area in which the two 8-bit slots reside.

The CPU and memory boards are installed in the first two 16-bit slots. The CPU board includes the 80386-25 processor, a socket for either the Intel 80387-25 or Weitek coprocessors, the BIOS chips, the Austek cache controller, and a 32K static RAM cache. The processor runs at both 25 and 16 MHz; at 16 MHz the cache is automatically turned off, while the expansion bus operates at 8 MHz. TeleVideo uses its own BIOS for this system, which

features a minimal setup procedure. Both shadow video and shadow BIOS RAM are featured, but you cannot disable them.

A 25-pin parallel and a 9-pin serial port are built into the memory board. The memory board has four banks of four SIMM sockets, supporting a total of 16MB of 100-ns. DRAM, in either 256-kilobit or 1-megabit SIMM units.

The CPU and memory boards are connected together in several ways. First of all, they are joined by a two-part 32-bit connector, giving all 16MB RAM a 32-bit data bus. Second, the boards are connected by machine screws. Since the CPU board is on the outside, the boards don't need to be disconnected from one another to add a coprocessor, but adding memory is not suggested for the faint-hearted.

The Tele 386-25 managed to turn in the slowest times of the machines reviewed here on PC Labs two-processor benchmark tests. Its performance on our memory, disk, and video benchmark tests fell into the middle of the pack. TeleVideo's unique system design doesn't seem to have increased performance for this class of machine. The margin separating the PC reviewed here, though, is not critical. Even with its unremarkable test scores, the Tele 386-25 offers solid 25-MHz performance.

The manual accompanying the Tele 386-25 is adequate, although incomplete in parts, and with some incorrect information, particularly concerning upgrading memory. TeleVideo representatives are correcting these errors. The manual does include some good advice on positioning expansion boards within the system, especially important in a box with so many expansion slots.

TeleVideo distributes the Tele 386-25 through distributors and VARs, which discount the list price. A generous warranty

includes one year of parts and labor plus one year of on-site support. The Tele 386-25 includes some innovative design features, even if it's benchmark performances were uninspiring. But what makes this system worth considering is its expandability and its support policy.

UNISYS CORP.
Unisys PW² 800/25A
by Bruce Brown

Unisys's 25-MHz 80386-based computer has a look that can be called "high corporate" and a price to match. This classy-looking combination desktop and vertical case gives up no performance or expansion edge to the less expensive brands, but it doesn't do much to justify the PW²'s high cost, either.

The base model PW² costs $7,315 with 2MB RAM and a 64K RAM cache. That's all you get for your money: there's no floppy disk drive, certainly no hard disk or video, no interface ports, no software, and not even a keyboard. A configuration with 2MB of RAM, 1.44MB floppy disk drive, 140MB hard disk, a Video Seven 16-bit VGA card and Unisys VGA monitor, two

serial ports and one parallel port, a 101-key keyboard with an 82-inch cable, and DOS 4.01 costs $12,466. If you want an Intel 80387-25 math coprocessor with a Unisys machine, it will cost you an extra $1,895, roughly the same as IBM and Compaq but at least three times the price charged by most of the vendors whose machines are reviewed in this issue.

The Unisys PW² 800/25A uses an Intel motherboard and 386 chip set with a Phoenix BIOS. The dual-speed 8- and 25-MHz system clock includes the slower speed for booting recalcitrant software, but otherwise the machine is intended to run at full speed. The expansion bus powers one 8-bit, five 16-bit, and two 32-bit slots at a steady 8 MHz.

The Unisys box measures 6.75 inches high (or 9.5 inches wide with the stabilizing feet when vertical) by 21.5 inches wide and 18.75 inches deep. The combination stand and integrated system foot is a beautifully designed piece that fits snugly on one side of the system case. The front of the case has a slight curve that adds to the system's design appeal, as does the FCC B sticker on the back of the case.

The Unisys did well on our benchmark tests, with good video speed scores combined with reasonable disk, processor, and memory performance. It doesn't justify its price by yielding the highest performance, but it surely holds its own.

The Unisys motherboard can hold up to 2MB RAM, using SIMMs. The installed chips were rated at a fast 60 nanoseconds, which partly explains the higher overall system cost. A memory board in the 32-bit slot can take up to an additional 16MB, raising the system potential to 18MB of 32-bit memory. The memory cache is fixed at 64K of 35-ns. memory chips, with cache management accomplished by discrete chips integrated into the motherboard.

There's room for five half height drives in the Unisys case, three of which can use removable storage media. The standard 220-watt power supply is ample for the system's expansion possibilities.

Don't expect to buy Unisys computers through the mail or at your local discount computer store. Unisys sells through dealers and via a direct sales force, targeting a clearly defined market: big business. Corporate buyers who use Unisys mainframes and workstations or buy from full-service vendors are the intended market, and also

the only ones likely to be willing to pay the relatively high price for this machine; but look for discounts. A one-year parts and labor warranty is standard, with warranty extensions and on-site service available by negotiated contract.

The Unisys 386 25-MHz computer comes in an attractive package and performs well. Unfortunately, the base unit costs more than IBM or Compaq and is less well known, so it's easy to see the difficulty that Unisys has in gaining ground in the personal computer market.

WYSE TECHNOLOGY
WYSEsystem 386 Model 3225
by Catherine D. Miller

Wyse Technology continues its tradition of modular system architecture with the 25-MHz WYSEsystem 386 Model 3225. Because it's designed around a CPU on a board, many of the machine's components are engineered by Wyse Technology to insure an integrated system unit. Although Wyse has not yet announced a 486-upgrade board, that seems to be the logic at work behind the Model 3225.

The basic system, which carries a list price of $7,599, includes 4MB of 100-nanosecond RAM, a 25-ns. 64K cache, a Western Digital ESDI hard/floppy disk controller, a 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, a 220-watt power supply, a 101-key keyboard, and DOS 3.3.

The stylish light-gray 5.25- by 21- by 17.25-inch (HWD) desktop case houses five half-height drive bays, four of which are accessible from the front of the system.

Unisys PW² 800/25A
The Unisys PW² 800/25A is corporate machine with an elegant combination tower-desktop case and a Fortune 500 price. With 2MB RAM, 146MB hard disk, 1.44MB floppy disk drive, VGA, and DOS, the system costs $12,466.

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A removable cover slides over the drive bays when they're not in use. A diagonal LCD panel displays the date or time, and the processor speed, which can be set to 8 or 25 MHz with a button located directly below the LCD screen.

Inside you'll find eight 16-bit and three

WYSEsystem 386 Model 3225
The WYSEsystem 386 Model 3225 features a backplane design with the CPU on a card for 486 upgrades. With 4MB RAM, 150MB hard disk and tape drives, a 1.2MB floppy disk drive, VGA, and DOS, $11,173.

8-bit slots, but by the time the system is configured with a video adapter, disk controller, and I/O ports, only five slots are left open. The processor, system memory and cache memory each reside on separate boards occupying three 16-bit slots. A 32-bit top-plane, which is held in place with a clamp and cover plate screws, connects the three boards so that the system operates with a 32-bit bus. The bus operates at a constant 8 MHz. Directions for the removal of these three units and the removal of the top plane are placed on the inside cover of the system, along with the jumper and switch settings for the CPU board and memory board, as well as other system specifications.

Ten of the eleven expansion slots on the backplane are located along the rear of the computer, so boards are installed in the conventional vertical manner. The controller board resides in a space-saving eleventh slot, which is located horizontally next to the drive bays so as not to crowd the system.

CPU IN CHARGE

In addition to incorporating Intel's 80386-25 processor, the CPU board includes a socket for the Intel 80387-25 coprocessor. Phoenix ROM BIOS chips supply the standard setup and utilities associated with this BIOS, including shadow video and BIOS RAM and password protection.

The CPU memory card features four banks of SIMMs that can contain 16MB of 32-bit memory available with all four banks full. A socket and support circuitry for the Weitek 3167 coprocessor is located on the cache memory board. A 64K direct-mapped posted write cache composed of 25-ns. chips is standard and cannot be increased. Wyse controls this cache with chips of its own design.

In addition to the basics, our $11,173 evaluation unit included CDC's 150MB hard disk drive, a 150MB streaming tape drive from Archive, Wyse's 8-bit VGA board, and Wyse's VGA monitor. Wyse doesn't offer a hard disk drive independently of the tape drive; you must buy both if you buy your hard disk from Wyse. While I won't dispute the importance of backup, you should be able to choose the method that best suits your needs.

The WYSEsystem turned in a competitive performance on the PC Labs benchmark tests, doing especially well on the small-record DOS File Access and BIOS Disk Seek tests. The Model 3225's sluggish performance on our video benchmark tests (last place in the Direct to Screen test) is attributable in part to the 8-bit VGA board installed in our evaluation unit.

The manual accompanying the WYSEsystem 386 Model 3225 is adequate for most purposes, although it is a little sparse when it comes to describing the system's setup procedures and utilities. Wyse Technology distributes the Model 3225 through distributors and larger VARs that will set up the system and offer service and support. Wyse offers a one-year parts and labor warranty, with an optional on-site service policy also available.

Wyse offers a high-quality system with some unique design features. Although it commands a higher price than many 25-

All the PCs reviewed in this issue are competent performers, with benchmark results well within the expected range for their class. None of these 25-MHz machines will let you down, but none measure up to the three Editor's Choice winners from *PC Magazine's* May 30, 1989 386 blockbuster. For that reason, we aren't awarding an Editor's Choice to any of the PCs in this roundup. Our favorites remain the three Editor's Choice machines from DataWorld, IBM, and Northgate.

The 13 machines reviewed here represent the third group of 25-MHz 386 PCs that *PC Magazine* has evaluated this year. In those ten months, 25 MHz machines haven't gotten any slower, yet they've slipped from being the fastest PCs around to the second fastest and now, with the advent of the 486, to third. Already we're beginning to see the beginning of community marketing for 386-25s.

We looked at nine machines in our February 14, 1989 issue, and the Dell System 325 emerged as *PC Magazine's* first 326-MHz Editor's Choice. The System 325 currently lists for $6,899 with 1 MB RAM, a 150MB hard disk, Super VGA (800 by 600 resolution), and DOS.

Twenty-five 25-MHz PCs were evaluated in our comprehensive May 30, 1989 round up. By then time had caught up with the Dell, and although it remains a well-constructed, reliable PC, it was no longer among the fastest 25-MHz 386s. The 25-MHz Editor's Choices selected in May, and the ones that we consider still the best 25-MHz 386s, are the DataWorld Data 386-25, which comes with 1MB RAM, 140MB hard disk, Super VGA, and DOS for $5,435, and the Northgate Elegance 386/25, which costs $5,124 with 1MB RAM, 150MB hard disk, Super VGA, and DOS. Also winning the Editor's Choice was the IBM Micro Channel PS/2 Model 70-A21. Although the A21 experienced some system board failures, IBM has corrected this problem, and we still consider it an Editor's Choice PC. The IBM lists for $11,113 with 4MB RAM, a 120MB hard disk, and a VGA monitor. Note the IBM includes more memory, and since it is sold through dealers, you should be able to negotiate a 20 to 30 percent discount.

Among PCs reviewed this issue, our favorite (though not Editor's Choice) is the ACMA 386/25 Business System. The ACMA stands out for its performance (consistently finishing third or better out of 13 machines), good expansion possibilities, 45-day money-back guarantee, and a two-year warranty. Its $3,595 price tag for 4MB RAM, 120MB hard disk, VGA, and DOS, makes it an attractive choice.

The Micro Labs 386/25 from Pan United Corp. is a good value offering fast performance. It sells for $4,600 with 4MB RAM, a 120MB hard disk, VGA monitor, and DOS, and uses brand name components.

If you're hungering for expansion capability, take a look at the PC Craft 3500/25C. This tower unit accommodates one full-height and eight half-height drives but costs $9,240 with VGA and a 150MB hard disk. The Mitac, Unisys, and Wyse entries also charged premium prices for solid yet unexceptional performance.

MHz 386 systems, it's a solid performer and well supported. Give it a look. ■

Catherine D. Miller is a staff writer at PC Magazine. Bruce Brown, a frequent contributor to PC Magazine, is a computer consultant based in Simsbury, Connecticut.

Amazing Performance

"Faster Than a Speeding Bullet!"

Cover Story Nov, 1988

"PC Brand offers the best low cost alternative around"
PC Magazine Feb.14, 1989

PC BRAND 386/20 $1489

20 MHz Clock, Zero Wait Operation
Norton SI 23.0 • Landmark Speed 26.1MHz
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:
- True 20MHz Intel 80386-20 CPU Operating with Zero Wait States delivering up to 26.1MHz Effective Throughput
- 1024K RAM standard expandable to 16MB using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.5 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-Key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:
- Full or Mini Size Tower ∗ Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable ∗ Weitek Co-processor

Standard Pre-Built Configurations:

386/20 With 1024K, Hard Disk Drive, Monitor & Video Card						
Drives Video	40MB-65MS 1:1 MFM	64MB-29MS 1 RLL	71MB-19MS 1:1 RLL	121-25MS 1:1ESDI	151-17MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$1995	$2095	$2220	$2330	$2860	$3305
VGA/Mono	$2170	$2270	$2395	$2505	$3035	$3480
EGA	$2280	$2380	$2505	$2615	$3145	$3590
VGA/16Bit	$2370	$2470	$2595	$2705	$3235	$3680

PC BRAND 386/25 $1689

25 MHz Clock, Zero Wait Operation
Norton SI 28.2 • Landmark Speed 33.6MHz
Norton SI 31.6 • Landmark Speed 43.5 w/Cache
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:
- Intel 80386 Processor Operating at 25MHz with Zero Wait States in interleave mode delivering 34 to 44 MHz Effective Throughput
- 1024K RAM standard expandable to 16MB using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 or Weitek Co-Processor Support
- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 5 Disk Drive bays (Full size case w/cache)

Options:
- 32KB or 64KB Cache Processor ∗ Weitek Co-processor ∗ Tower ∗ Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

Standard Pre-Built Configurations:

386/25 With Hard Disk Drive, Monitor & Video Card						
Drives Video	40MB-65MS 1:1MFM	64MB-29MS 1 RLL	71MB-19MS 1:1 RLL	121MB-25MS 1:1ESDI	151-17MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$2182	$2332	$2462	$2592	$3162	$3412
VGA/Mono	$2387	$2537	$2667	$2797	$3367	$3617
EGA	$2502	$2652	$2782	$2912	$3482	$3732
VGA/16Bit	$2577	$2727	$2857	$2987	$3557	$3807

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The New Lotus 1-2-3s

Excel Quattro SuperCalc5
Release 2.01 Release 2.2 Release 3

Just Enough, Just in Time

The two new versions of Lotus 1-2-3 have a wealth of new features that millions of users have been awaiting impatiently. Are they good enough to win back those who have found the same features elsewhere?

by M. David Stone

You've heard all about *Microsoft Excel*, and *Quattro Pro*, and *SuperCalc 5*, but you've stayed with *Lotus 1-2-3* 2.01 because you know its menus by heart and the program does what you need it to do—more or less. But now that Lotus has delivered not one but two new releases, the question becomes not just whether to upgrade, but which one to upgrade to: Release 2.2 or Release 3.0. Microsoft Corp., Borland International, and Computer Associates International

would say "neither!" and satisfied users of their spreadsheets would agree.

Lotus Development Corp.'s two new releases, which both list for $495, have clearly differing hardware requirements. Release 3 needs a 286 or 386 processor, a hard disk, and 1MB of memory (3MB for OS/2 operation), while Release 2.2 can run on a dual floppy system with an 8088 and as little as 320K. Lotus would have you base your upgrade decision strictly on the hardware you have or intend to buy,

COMPUTER ILLUSTRATION: CHARLES CROGONER

but it has confused the issue by making the two releases just different enough to make the decision a little more difficult than that. The versions share some new commands, but each has features the other lacks.

Release 3 offers 3-D worksheets (a stack of connected worksheets in the same file), links to external databases, and the ability to see a graph and worksheet simultaneously. Release 2.2 offers none of the above—the penalty for being able to run in 640K or less. But 2.2 is not simply a subset of Release 3. Most notably, 2.2 comes bundled with *Allways*, an add-in that can produce output every bit as attractive as anything you've seen from *Excel*. *Allways* provides shading, boxes, and up to eight fonts per worksheet, yielding far more professional-looking output than Release 3 can produce.

You'll also find a handful of menu choices in Release 2.2 (for add-ins and macro item mode) that you won't get in Release 3, and 2.2 provides setting sheets—a feature that gives you an overall view of relevant settings for a given function. For example, when you are working in the Graph menus, the setting sheet lets you see all of your graph settings at once.

Moving from 2.01 to either 2.2 or 3.0

feels comfortable, like discovering new sides to an old friend's personality. But moving between 2.2 and 3.0 has a *Twilight Zone* feel to it, as if you've slipped into another dimension.

Some of the differences between the two upgrades are temporary. According to Lotus, future versions of Release 3 will in-

corporate setting sheets and the add-in menu choices that are already in 2.2.

Lotus says that the only reason for leaving the add-in choice off the Release 3 main menu is that there aren't any add-ins for this product yet (it claims that 2.2 will work with most add-ins designed for 2.01). Release 3's new programming means that add-ins have to be rewritten from scratch. Until add-ins for Release 3

Setting sheets in 1-2-3, Release 2.2, like the Graph setting sheet shown here, make it easier to navigate the menus. You can see what you've already done and make changes within context. There's no need to waste time on trial and error.

RELEASE 3's MEMORY MUDDLE

by M. David Stone

Lotus 1-2-3, Release 3, requires a minimum of 1MB RAM for DOS—640K conventional and 384K extended. But does it really need all that memory? And does that big requirement mean that you can't load your network software or favorite TSR?

No, it doesn't, and no, it doesn't. The RAM requirement is more complicated than the simple 1MB that Lotus states. In fact, there are complications with both the extended memory and the conventional memory.

Extended memory first: On the one hand, many computers with 1MB of RAM are already using all or part of the 384K extended memory for shadow RAM. This helps speed up the computer's operation but may prevent Release 3 from running. On the other hand, 386-based PS/2 systems and Compaq systems also use shadow RAM, but Lotus worked with IBM and Compaq to ensure that there would be no conflicts. In general, the more extended memory

your computer uses for shadow RAM, the more likely you are to have a problem, particularly if the system can't be configured to turn off the shadow RAM. (You can always sidestep the problem by adding more extended memory.)

The requirement for conventional memory is even less clear. The Lotus manual states that if you don't have enough memory available, "part of *1-2-3* is stored in overlays on the hard disk." The implication is that Release 3 doesn't need all that memory after all. This turns out to be true.

We ran Release 3 in a *DESQview* window set to 480K. Even then, the Worksheet Status screen showed 226K free. The program also ran without problems in the 480K window with *SideKick* loaded first.

Beyond *DESQview*, Release 3 worked fine with *Lotus Express*, with only 273K of conventional memory available after loading the memory-hungry comm program. With *Express*

loaded, the program wouldn't let me use the /System command to shell out to DOS. Instead, it responded that there was not enough memory available.

Lotus was not able to come up with firm figures for the memory Release 3 minimally needs; the figure changes, depending on your DOS version, which screen drivers and printer drivers are installed in Release 3, and how many drivers are installed.

According to Lotus, Release 3 loads as much as possible into extended memory first. If you have enough extended memory (750K), Release 3 will load all but 30K into that. With extended memory filled, the program then loads the rest into conventional memory. In the real world, you'll simply have to try the program with your favorite TSRs and see if they work. But if you plan to create large spreadsheets, you'd better have some expanded memory (up to 32MB addressable) or additional extended memory (up to 15MB addressable) as well.

from scratch. Until add-ins for Release 3 arrive and Lotus incorporates the menu choice, the add-in manager is available through Alt-F10, just as in 2.01. To maintain consistency, 2.2 can also bring it up with Alt-F10.

Lotus has also announced that *Allways* for Release 3 will be available "at a nominal cost," with details to follow when beta testing begins. Once Release 3.x matches

the few advantages that 2.2 currently has, it will offer a true superset of 2.2 features. It makes sense, then, to consider the two programs together, since 2.2 offers some hints as to what 3.x will become.

VALUABLE CONNECTIONS

The most significant new features in the releases are linking (in both versions) and 3-

D (in Release 3 only). Both linking and 3-D are sure to change the way you design spreadsheets, since they let you spread your models over several connected worksheets.

There is an important distinction between linking and three-dimensionality. To link worksheets, you only have to be able to read the contents of cells from one worksheet into arbitrary cells of another, a feature that you'll find in both 2.2 and 3—and in the program I had eight years ago on my CP/M computer, for that matter. For three-dimensionality, you also need the ability to extend ranges through a stack of worksheets, just as you can extend them horizontally and vertically on a single worksheet.

Even 2.2's meager ability to link worksheets opens new possibilities. With linking, it's a trivial matter to build a simple accounting system: Start with a template for income and expenses and create a worksheet for each account as needed. Then build a chart of accounts worksheet that links to each income or expense sheet and reads the current totals.

If the total for each expense sheet is in cell D100, for example, the link formulas in the chart of accounts would take the form

+<<EXPENSE1.WK1>>D100

The double angle brackets indicate that EXPENSE1.WK1 is a filename. If you wish, you can also include a complete path and drive letter.

Each time you load the chart of accounts sheet, it will update the linked formulas from disk. If you're on a network and think someone may have changed one of the source sheets, you can update the figures manually with the /File Admin Link-refresh command.

In 2.01 you could use the /File Combine Copy command along with macros to get much the same effect, but you'd have to work at it. Linking lets you consolidate information easily—which means you are more likely to take advantage of it.

Linking in Release 3 works almost the same way it does in 2.2, with one exception and many enhancements. The exception is that Release 3 does not automatically update data from disk when you load a file.

There is at least one reason for leaving out the automatic update. One of the key features in Release 3 is the ability to load

multiple files. If you've already loaded a source worksheet and modified it, you obviously don't want the linking formulas to read the out-of-date data still on disk.

Release 3's solution is to read data automatically only when the source worksheet is in memory. The program will even update link formulas as you make changes in the source file. It will not read the data from disk unless told to with the /File Admin Link-refresh command, and then it will sensibly ignore the data from disk if it differs from data in the same worksheet in memory.

Alas, this is one difference that is clearly in 2.2's favor. Lotus was no doubt trying to cut down file-loading times in Release 3, but it would be better to take the

> Features like linking
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extra time to make sure you're working with the most-current data. As it is, you can use an auto-executing macro in files with link formulas to run the /File Admin Link-refresh command after loading.

Of course, Release 3 can link to .WK1 and .WKS files as well as to the program's native .WK3 format. This makes consolidation easy, even when the worksheets are created with other versions of *1-2-3* or compatible programs. (Release 2.2, which uses the .WK1 format, can link to .WK1 or .WKS files, but not to .WK3 files.)

One notable feature in Release 3's linking is the ability to include @ functions and ranges in the link formula. For example, you can create a formula such as @sum<<[JANEXP.WK3>>ITEMTOTS

This will look at the JANEXP file, find the range ITEMTOTS, and return the sum of the entire range. To do the same thing in 2.2, you have to create an extra formula in the JANEXP worksheet to total the amount, then read the total from there. Clearly, that's a less elegant approach than entering one formula in Release 3.

LINKED VS. 3-D WORKSHEETS

The distinction between three-dimensionality and linking is one that is important enough to repeat: three-dimensionality refers to the ability to extend ranges through a stack of worksheets in a single file. Linking does not.

It doesn't make much sense to define a named range by extending it through multiple files. The next time you load the files, you can load them in a different order. On the other hand, if the worksheets are all part of one file, you will automatically have them in the same order every time, so having a range in the third dimension becomes meaningful.

Some programs eliminate confusion between linked and 3-D worksheets by offering only one choice. Excel, for example, uses a different file for each worksheet. The only trouble with having both options in Release 3 is that they seem so similar that you may have trouble sorting out the differences. The benefit is that once you understand the differences, you can

SEYMOUR ON SPREADSHEETS: Do Lotus's New Releases Succeed?

by Jim Seymour

It just *seemed* like forever. From its formal announcement in April 1987, at the first *Lotus Week* celebration in Boston—at the peak of Lotus's power, when it seemed the company could do no wrong—till *Lotus 1-2-3*, Release 3, was shipped in July 1989 didn't really take all that long, as software products go: 26 months.

But since the last major release, 2.0, had appeared in September 1985, we had thought 3.0 would arrive long before the Summer of '89. And the combination of our expectations, based on working with previous Lotus spreadsheet programs, and the hype Lotus brought to the party during those 26 months, meant that we were all expecting something pretty spectacular in Release 3.0. With every delay over those two years, those expectations got cranked a bit higher: anything that takes *that* long must be pretty incredible, right?

Even Lotus's announcement in March of this year that we'd be seeing not one but two new *1-2-3s* and a third one sometime next year hardly dampened the passions.

OK, so Lotus found it couldn't pack all the goodies it had built into 3.0 into 640K and had to turn to a DOS extender so that the program could use extended memory. Upgrading system memory is a Good Thing; this is the era of megamemory, right?

OK, so rewriting 3.0 in the C language, rather than the faster, tight assembler code of earlier versions meant 3.0 might not be so fast as we were used to. C'mon: Speed isn't really *that* important, is it?

OK, 3.0 can't turn out good-looking printed worksheets the way you can with 2.01 and the bundled *Allways* add-in from Funk Software. So what? Attractive printouts aren't all *that* important, are they?

We ran out of OKs when *1-2-3*, Release 3, actually shipped.

INHERITING THE MANTLE

Is *1-2-3* 3.0 a great spreadsheet program? Of course: with the exception of the spreadsheet built into Lotus's forlorn *Jazz* for the Macintosh, Lotus has never shipped a spreadsheet program that wasn't a great piece of software. Even *Symphony*, with its warty interface, confusing design, and sorry word processing had within it from the first a state-of-the-art spreadsheet . . . which was just another way of saying a *Lotus* spreadsheet.

And that's the problem: It's hard to call *1-2-3* 3.0 a *state-of-the-art* spreadsheet, perfectly nice though it is.

Fairness time: There are lots of swell things in *1-2-3* 3.0. There's 3-D, for example: you can build stacks of either same-format worksheets (a "multiplesheet file," in Lotus-ese), or varying-format worksheets ("linked files"), then produce cover sheets, or "roll-ups," which gather and summarize the detail from all those underlying sheets.

And you can have a *1-2-3* 3.0 graph on-screen, in a "HotView" window, right along with a few of the rows and columns of the worksheet itself.

And the database features have been improved, by the addition of powerful multivariable file capabilities. You can also snatch data relatively easily from external database files; Lotus includes a *dBASE III* driver, and we'll surely see others from the DBMS vendors and

third-party software companies.

And there's a learn mode for creating macros, a few obscure new @ functions, better recalculation algorithms, a long-overdue search-and-replace function, and real support for LANs.

STAND AND DELIVER

But, but, but . . . all those OKs start piling up: Were we really going in the right direction when we had to keep dropping desirable features, from 640K operation to good-looking printouts to decent-quality graphs to the kind of blazing speed we've always associated with Lotus spreadsheet programs?

In return we got new functionality in 3.0, but too often the new goodies are less useful than they at first seem. Lotus's addition of 3-D capability is a perfect example. While *1-2-3* 3.0 gives users access to both kinds of 3-D spreadsheets—multiple-sheet files of same-format worksheets and linked files of dissimilar sheets—Lotus did a lot better job with the former than the latter.

Creating multiple-sheet files in 3.0 is direct and simple. A new command, /Worksheet Window Perspective, spreads up to three of those separate sheets across your screen at once and makes jumping from one to another easy. And a related /Worksheet Window Group command lets you format cells and ranges three-dimensionally, to keep those worksheets formatted the same way.

But building the second kind of 3-D worksheet, which is richer and more complex—the linked-files flavor—is less convenient. You'll find yourself slipping and sliding around as you try to navigate through related worksheets, looking for the cells you want to link.

use whichever approach is most appropriate. Multiple linked files are a good choice for data that comes from multiple sources, while 3-D spreadsheets are a fine choice for files that are completely under your control.

If you can keep the two concepts separate, you shouldn't have much trouble working with either format (Jim Seymour has a decidedly negative reaction to Release 3's handling of multiple linked files, however. See "Seymour on Spreadsheets:

Do Lotus's New Releases Succeed?"). The key is to consider multiple files in memory as nothing more than a shortcut. It saves you from having to clear one file from memory before you can work on the next, but it offers little else. When you use the /Worksheet Window Perspective command to see three worksheets at once or Ctrl-PgUp and Ctrl-PgDn to move through the worksheets on-screen, it may look ex-

This isn't all Lotus's fault: *Microsoft Excel* shows how much help it is to have a graphical environment when you're working in three dimensions. Maybe Lotus will deliver state-of-the-art 3-D worksheet capabilities when the *next* version of *1-2-3*, the graphically oriented *1-2-3/G* for OS/2 with Presentation Manager, ships sometime next year.

HARD CHOICES

No program exists in a vacuum. We judge software by how it compares with other programs of the same type. And *1-2-3* 3.0 isn't so hot when you stack it up against the competition—including Lotus's own competition for 3.0.

Microsoft Excel, though in need of an upgrade (reportedly coming this fall), already delivers a richer set of tools, superior functionality and output, and the benefits of working in a graphical environment. *Excel*'s speed roughly matches *1-2-3* 3.0's, except for the time required to load the program and save files, where its *Windows* overhead drags *Excel* down.

Borland's new *Quattro Pro* 2.0, which should be shipping about the time you read this, offers some of *Excel*'s advantages. For example, it can have up to 32 files open at once in 3-D work, each file in its own window—in the character-oriented environment of plain-vanilla DOS. Navigation and linking are also easier than in *1-2-3* 3.0, and with comparable or better speed.

Finally, for many people both the hoary *1-2-3* 2.01 and Lotus's new Release 2.2 are better choices than Release 3.0. Certainly *1-2-3* 2.2 is a nice upgrade from 2.01, though it gives up a little in raw performance. Among other

things, you forgo 3.0's 3-D features, enhanced database, and access to megamemory—2.2 allows just one worksheet of 256 columns by 8,192 rows in memory, while 3.0 can (theoretically) manage 256 worksheets at once, each of that size. But you get the smarter recalculation, search-and-replace, learn-mode macros, and much of the rest of *1-2-3* 3.0.

More importantly, you get the superior output of *Always*, as well as access to the whole range of existing *1-2-3* add-ins.

Still, *1-2-3* 2.01 users have to ask how much those new features of 2.2 are worth. For many, doing nothing for now may be the right answer.

DIMINISHED EXPECTATIONS

What happened with *1-2-3* 3.0 is a window into the future of the PC software market. Because our first encounters with PCs brought revolutionary changes in how we work, many of us expect each new release of our favorite software to effect that same kind of leap, the kind of whack on the side of the head we got the first time we loaded *1-2-3* 1.0, or *dBASE II*, or even, God save me, *WordStar*.

But PC software has become an evolutionary, not revolutionary, business. In a world of incremental improvements, tensions between the vendor's ability to deliver steady improvements and our expectations of soaring innovation are inevitable.

Lotus 1-2-3, Release 3.0—and maybe, our expectations—is the first victim of that conflict. ∎

Jim Seymour is a contributing editor of PC Magazine.

the worksheets on-screen, it may look exactly the same as when you have multiple worksheets in the same file. In fact, it may use some of the same commands, and the feature may even allow the same maximum of 256 worksheets to reside in memory at once. But it's a completely different situation.

Release 3 provides a few aids to make linking easier. If you want to link a cell in one worksheet to a cell in another, you don't have to type the formula. You can move to the cell the formula will go in, type +, then use cursor movement keys to move to the worksheet and cell you want to

link to. Hit Return, and Release 3 will enter the link formula—including drive, path, filename, and cell. If you want to, you can follow much the same strategy to define an @ function and range.
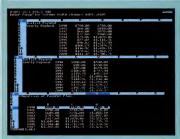
All this is straightforward. Indeed, it's a natural extension of the point-and-shoot strategy of 2.01. However, you can't do much more with multiple linked files. You can't copy data to more than one file at a time, because Release 3 won't let you define a multifile range. If you want 3-D features, you have to put all your worksheets

in one file.

3-D WORKSHEETS
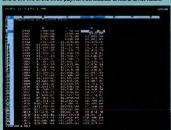
When you load Release 3, the screen is essentially the same as in 2.01 or 2.2, although the characters look different on a graphics monitor since they are created as bitmapped graphics. There are, however, two differences to spot on the screen: an A sits at the top-left corner of the worksheet, and the current cell indicator reads A:A1, rather than A1.

The first A indicates that you are on the first worksheet in the file. To create additional worksheets, you use the /Worksheet Insert Sheet command, designate whether
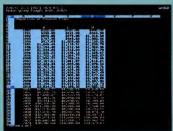
TAKING ADVANTAGE OF RELEASE 3's NEW FEATURES
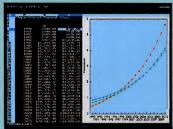
1. This 3-D model compares three schedules to determine when the most expensive initial payment schedule becomes the least expensive for out-of-pocket expenses. Sheet A is the consolidation sheet. Sheets B and C are two of the three payment schedules. Sheet D is not visible.

3. Release 3's new /Graph Group command will let you define the x-axis and data ranges for a graph all in one step. Note that in all these screens, the display is set for EGA's 43-line mode so that as much data as possible can be displayed on the screen at one time.

2. Here, we've cleared the three-window view in preparation for creating a graph of the payment schedule model. The cursor position tells Release 3 where to position the left edge of the graph.

4. With the graph defined, issue the /Worksheet Window Graph command to show your graph with the worksheet. This graph is too small to show the points where the out-of-pocket costs become less expensive.

to insert before or after the current sheet, and enter the number of sheets to insert. If you want to see more than one worksheet, enter the /Worksheet Window Perspective command, and *1-2-3* will show you three worksheets on-screen.

Once you create the additional worksheets, you can treat them as simple extensions of the top worksheet. Suppose you want to see sales broken down by month, product, and region. Simply enter the products on Worksheet A in column A, the regions in row 1, and the appropriate formulas to total the figures. Then copy the entire range of entries to all the other work-

sheets in the stack so that you can enter one month's figures into each worksheet.

To copy, you use the /Copy command as usual. When *1-2-3* asks for the range to copy to, move to the upper-left-hand corner of the range you're copying from, tack down the cursor with a period, then move through the spreadsheets with Ctrl-PgUp or End Ctrl-PgUp to go to the last worksheet in the file. When you reach the last worksheet, tap Return, and *1-2-3* will copy the text and formulas. Note that this is a simple extension of the commands you al-

5. With the graph still showing on-screen, you can go back to the /Graph menus and redefine the graph; in this case the graph now shows a shorter period of time.
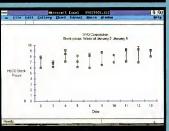
6. After you redefine the graph, Release 3 redraws it. Now you can see that the schedule that is least expensive to begin with becomes the most expensive in 1998, while the schedule that is the most expensive at the start yields the lowest out-of-pocket costs starting in 2005.

1-2-3 VS. TWO GRAPHING CHAMPIONS

One of Release 3's best new features is its enhanced graphics. To demonstrate what's possible in Release 3.0 and what you'd get with the same data and design in *Microsoft Excel* and *Harvard Graphics*, we created imaginary stock prices for a two-week period for the bogus XYO Corp. Stock fluctuations were represented in high-low-close-open (HLCO) graphs.

Lotus 1-2-3 users can finally display high-low-close-open graphs in Release 3. (Users of *Lotus Signal*, the stock-quote-importation program, know that earlier versions of *1-2-3* and Release 2.2 do not allow this.) Note the color and font-sizing touches. This is the only HLCO design in *1-2-3*.

Microsoft Excel 2.10 uses a graph design similar to Lotus's to create HLCO graphs. The big difference is that with *Excel* you get many more customization features, including color, font, text, and pattern manipulation.

You can show HLCO numbers three ways with *Harvard Graphics*: as *error bars*, as bars with horizontal lines for open and close values, and as an *area* chart, with data displayed in a range. This graph uses the bar method. *Harvard Graphics* allows customization of the bars' sizes, orientation, and fills.

tures are just as straightforward.

One feature worth special mention is the /Worksheet Global Group command. With the Group feature turned on (as indicated by the word *GROUP* at the bottom of the screen), most changes you make to one worksheet in a file will apply to all of them. This includes changes in column width and insertions or deletions of rows and columns. The Group feature saves you from having to define a 3-D range for each command. If you need to format the sheets independently, you simply toggle the Group feature off.

GOOD-LOOKING GRAPHICS

Complaints about *1-2-3*'s graphics probably began as soon as there was another program to compare it with. The good news is that Lotus has made real improvements in its graphics in both new releases.

Release 2.2 still has the familiar Print-Graph, but Release 3 has gotten rid of it. To print a graph in Release 3, you use /Print Printer Image to designate the graph, then print with the /Print Printer Go command. Choices for controlling color, font, cross-hatching, and other features are in the Graph menus, under /Graph Options Advanced. Other controls—for graph size, rotation, and density—are in the Print menu, under /Print Printer Options Advanced Image.

Release 2.2 has taken a step away from PrintGraph, thanks to the inclusion of *Allways*. To print a graph with *Allways*, you create a .PIC file, as you do with Print-Graph. You then go to *Allways* and use the /Graph Add command to choose the .PIC file and position the graph on the spreadsheet. Positioning the graph is much like creating a range, so you automatically control graph size and aspect ratio when you define the position. You can then designate a print range that either includes the graph or doesn't.

A nice touch with *Allways* is that you can print the spreadsheet and graph with one command. You can also attach several graphs to one spreadsheet and print them all on the same page. The only way to print graphs and text on the same page with Release 3 is to print the text first, then the graph, adjusting the size and position of the graph to fit on the page.

Mechanics of printing aside, both new releases offer improvements in the look of the graph. For example, instead of crowding the *x*-axis by keeping all the labels in one line, both 2.2 and 3 will automatically create two lines if needed and alternate the

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text between them (though 3 does a better job of this). Similarly, whereas 2.01 will crowd a bar graph by butting the left- and rightmost bars against the frame, 2.2 and 3 both leave space between the bars and the frame. The net result of these changes adds up to far-better-looking graphs, both on-screen and on paper.

Other graphics features in Release 3 include new graph types, such as hi-lo-close-open, area, and mixed. One last feature is the /Worksheet Window Graph command, which will show you a graph on-screen along with your worksheet. This lets you change numbers in the worksheet or adjust settings for the graph and watch the effect on the graph. The feature is just as impressive to watch in 1-2-3 as it is in Excel. You cannot see multiple worksheets and the graph at the same time, but you can page through your worksheets with the graph showing, and make any changes you like.

DATABASE FEATURES

Release 2.2 has no database features beyond what you find in 2.01, but Release 3's database features have been pumped up to the point where they invite a close look—especially if you've decided

that 1-2-3 is too weak to be taken seriously as a database program.

Among other new features is the ability to create queries that combine data from two or more tables. The mechanics are much like any other query, except that you first create a "join" formula that establishes an equivalence between the keys in two

tables—for example, +ZIP=ZIPCODE, where ZIP and ZIPCODE are each in a different table. You then enter both table ranges in /Data Query Input by separating the ranges with commas. Release 3 combines data from both tables when you use the Extract command.

This join feature gives Release 3 some
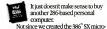
Allways provides a reasonably WYSIWYG environment to let you see what your output is going to look like. Allways can provide shading, a grid, and different-size fonts, producing output that is a match for any other spreadsheet program you've seen.

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noteworthy relational database capabilities, but even more interesting are the new Data External commands. Although poor instructions in the manual guarantee it will take you some time to figure out how all this works, once you do, you'll be able to retrieve data from external database files and write data to existing files or create new ones. As shipped, Release 3 comes with a driver for *dBASE III* and *dBASE III Plus* files. Other drivers will be coming shortly—though Lotus has not yet decided on the means of distribution.

Other new database features in Release 3 include the ability to sort on up to 255 keys and create calculated fields in the output range. There are also new macro commands that let you create data-entry forms.

If you've been using *1-2-3* as your database manager, you'll find that Release 3 will let you do a lot more. If you haven't been using the database functions, you'll find enough new features to make them worth trying now.

FINALLY, AN UNDO
One last notable new feature is Undo. In both releases, you can turn Undo on and off with /Worksheet Global Default Other Undo Enable or Disable. You undo a change with Alt-F4. However, there is an important difference between the two releases. Undo in 2.2 is a toggle, meaning you can undo an undo. Undo in Release 3 is not as versatile.

The difference makes the 2.2 version of Undo a little more forgiving than Release 3's. Both releases treat any series of commands between an initial slash and the return to ready mode as a single operation. This means, for example, that you can go to the /Data menu, set up a query complete with ranges for input, criteria, and output, extract some data, escape back to Ready mode, hit Undo, and wipe out your range settings when all you really wanted to do was to undo the extraction. In 2.2, you can salvage your work by hitting Alt-F4 again, to undo the undo. In Release 3, you can't.

Release 3 tries to save you from this sort of mistake by asking you to confirm the undo before it actually proceeds.

Fortunately, even though you can't use Undo to toggle back to the previous state, Release 3 has a feature that can give you much the same effect—at least in some circumstances. Curiously, the manual doesn't mention it when discussing the Undo feature, but Release 3 includes a memory buffer that will automatically record your keystrokes at all times. In fact,

THE NEW LOTUS 1-2-3s: SUMMARY OF FEATURES

	Lotus 1-2-3, Release 2.2	Lotus 1-2-3, Release 3.0	Microsoft Excel, Version 2.10	Quattro Pro
GENERAL FEATURES	$495	$495	$495	$495
LAN version available	☐	■	■	■
OS/2 version available	☐	■	■	☐
Uses LIM EMS 4.0	■	■	■	■
Uses extended memory	☐	■	■	■
Maximum number of columns	256	256	256	256
Maximum number of rows	8,192	8,192	16,384	8,192
Usual number of rows displayed	20	20	Variable	20
Number of characters displayed	80	82	Variable	80
Maximum column width (characters)	240	240	Variable	Unlimited
Supports 8087 coprocessor	■	■	■	■
Supports 80287 coprocessor	■	■	■	■
Supports 80387 coprocessor	■	■	■	■
Supports mouse	☐	■	■	■
Includes mouse drivers	☐	■	■	☐
Supports full-page monitors	☐	■	■	☐
Auto-sensing (detects systems, printers, and so on)	☐	■ (graphics display only)	■	■
FILE FORMATS IMPORTED/EXPORTED				
.DBF	■	■	■	■
.DIF	■	■	■	■
Multiplan	☐	☐	■	☐
.PRN	■	■	■	■
Symphony	■	■	☐	☐
.TXT	■	■	■	■
VisiCalc	■	■	☐	■
.WKS	■	■	☐	■
.WK1	■	■	☐	■
GENERAL FEATURES				
Undelete	■	☐	■	■
Pointing for copying and moving	■	■	■	■
Row hiding	☐	☐	■	■
Column hiding	■	■	■	■
Cell hiding	■	■	■	■
Vertical titles	■	■	■	■
Horizontal titles	■	■	■	■
Numbers formatted as labels	■	■	■	■
High-order ASCII characters (128–255) displayed	■	■	■	■
Extract function (saves partial spreadsheet)	■	■	■	■
Warning against file overwrite	■	■	■	■
Automatic backup (.BAK files)	☐	■	■	■
User-customizable backup interval	☐	☐	☐	■
Auto-save can be disabled	■	■	■	■
User-customizable file extensions	☐	☐	☐	■
Nonalphanumeric symbols in filenames	■	■	■	■

■=Yes ☐=No

	Lotus 1-2-3 Release 2.2	Lotus 1-2-3 Release 3.0	Microsoft Excel, Version 2.10	Quattro Pro
Formulas displayed in worksheets	■	■	■	■
Cut-and-paste	■	■	■	■
Programmable hotkeys for shortcuts	■	■	■	■
Protect capability				
Rows	□	■	■	□
Columns	□	■	■	□
Cells	□	■	■	□
Macros	□	■	■	□
Formulas	□	■	■	□
MENUS				
Custom menus	■	■	■	■
Menus accessible via macros	■	■	■	■
Lotus-style slash and tree menus	■	■	□	■
Pull-down menus	□	■	■	■
First-letter-sensitive menus	■	■	□	■
ON-SCREEN DISPLAYS				
CapsLock toggle indicator	■	■	□	■
ScrollLock toggle indicator	■	■	□	■
NumLock toggle indicator	■	■	□	■
Insert/overstrike toggle indicator	■	■	□	■
Other	Undo	Group, zoom	None	None
Constant display of date	Optional	Optional	■	■
Constant display of time	Optional	Optional	■	■
User can set screen colors	□	■	■	■
Maximum number of splits on one screen	2	2	14	64
User can format split screens independently	□	■	■	■
User can scroll screens independently	■	■	■	■
RECALCULATION				
Row	■	■	■	■
Column	■	■	■	■
Natural	□	■	■	■
Logical	■	■	■	■
Manual	■	■	■	■
Automatic	■	■	■	■
Background	□	■	□	■
Intelligent	□	■	■	■
FUNCTIONS/OPERATIONS				
Math (including trigonometry)	17	17	22	18
Logic	9	8	6	8
Date and time	11	13	12	12
Statistics	7	10	14	10
Number of logical and arithmetic operators	17	17	20	20

you can't even turn the buffer off.

If you accidentally undo more than you meant to in Release 3, you can often recover your work by entering Alt-F2 to bring up the Record menu and picking Playback.

Playback is just what it sounds like—it plays back your keystrokes so you don't have to type them again. Even better, it lets you edit the buffer and select which keystrokes to play back. It's meant as a kind of ad hoc macro feature. But if you undo more than you meant to, you can use Playback to reenter your keystrokes. What's more, you can edit the buffer to correct whatever mistake you were trying to undo in the first place.

One extra that goes with the Undo toggle in 2.2 is that it also extends the spreadsheet's natural what-if capability. You can enter a change in your worksheet, undo it, and then toggle back and forth between the two states, without having to reenter any numbers. Similarly, you can load a second worksheet and use Undo to toggle back and forth between the two worksheets to compare them. This is no match for the 256 worksheets you can have in memory in Release 3, but it's still a nice touch.

BUT WAIT, THERE'S MORE

Releases 2.2 and 3.0 offer a laundry list of other new features. Both new versions know about networks and both provide controls—called reservations—that keep two users from changing the same file at the same time so that one user doesn't overwrite the changes made by the other. In addition, Lotus has announced network server versions for both releases; they should be available this fall. Prices for the network version of Release 3 are $695 for the server and $395 for a node license; Release 2.2's prices are $100 less.

There are also any number of small changes in both releases that add extra polish here and there. Both versions have screen drivers that will let you take advantage of options such as the 43-line mode of an EGA adapter. Release 3 will even let you install for two modes—25 lines and 43 lines on an EGA—and switch modes from within the program.

Other small but time-saving changes in both programs include the ability to define all the data ranges for a graph with one /Graph Group command and the ability to set the width of any number of adjacent columns with one /Worksheet Column Column-range command. Still more important is a Learn mode for macros in both versions. As with the Undo feature, Learn

THE NEW LOTUS 1-2-3s: SUMMARY OF FEATURES

	Lotus 1-2-3, Release 2.2	Lotus 1-2-3, Release 3.0	Microsoft Excel, Version 2.10	Quattro Pro
MACROS				
Auto-load macros	■	■	■	■
Learn mode for macros	■	□	■	■
Macro libraries provided by vendor	□	□	■	■
User-written macros can reside in worksheet or library	□	■	■	■
Macro menu	■	■	■	■
Macro branching	■	■	■	■
Looping macros	■	■	■	■
Conditional goto's	■	■	■	■
Imports working Lotus 1-2-3 macros	■	■	■	■
Imports other macros	□	□	□	■
DATABASE FEATURES				
Database can be larger than spreadsheet	□	■	■	■
Database resides partly on disk	■	Optionally	■	■
Number of simultaneous sort keys	2	255	3	5
Data record search by arithmetic criteria	■	■	■	■
Data record search by logical criteria	■	■	■	■
Database entry screen	■	■	□	■
Multidimensional database	□	■	□	■
Maximum number of levels	N/A	256	N/A	N/A
3-D SPREADSHEETS				
3-D spreadsheet linking	N/A	■		■
Number of levels	N/A	256	Unlimited	64
GRAPHS				
Graph types available	Bar, line, pie, stacked-bar, x,y	Area, bar, HLCO, line, pie, stacked-bar, x,y	Area, bar, column, HLCO, line, pie, scatter, combination	Area, bar, column, HLCO, line, pie, rotated-bar, stacked-bar, text-only

■—Yes □—No N/A—Not applicable: product does not have the feature.

works differently in the two releases, but it serves the same purpose.

If you use macros often, you'll also appreciate the ability to create macro libraries; this lets you use the macros in more than one worksheet without having to re-enter them in each one. Release 3 lets you put macros in their own file that you can load with any other file. Release 2.2 provides a macro library manager as a bundled add-in. Both programs break the 26-macro barrier by letting you assign a macro name of up to 15 characters; you can also assign up to 26 macros to Alt keys.

A particularly welcome change in Release 3 is that when you clear an error message, the program no longer dumps you back to Ready mode, forcing you to retype an entire command. Release 2.2 still has this annoyance.

Given all the new features, the Lotus menu structure is getting awfully old and creaky. There are now so many choices in so many different menu branches that it's hard to keep track of them all—particularly in Release 3, which has well over 200 new entries on its menus. In addition, too many menu choices use the same word to

	Lotus 1-2-3, Release 2.2	Lotus 1-2-3, Release 3	Microsoft Excel, Version 2.10	Quattro Pro
PRINTING FEATURES				
Controls color on-screen as well as in printing	■	■	■	■
Sizes fonts on-screen as well as in printing	■	■	■	■
Shows font styles on-screen as well as in printing	■	■	■	■
User can print directly from screen	■	■	■	■
Landscape printing	■ (with Always)	■	■	■
Box and shade output	■ (with Always)	❑	■	■
Multifont output	■ (with Always)	❑	■	■
PostScript printing	■ (with Always)	❑	■	■
Maximum characters in setup string	512	512	Unlimited	40
Number of printers supported	84 (70 with Always)	36	136	130
Customizable print drivers	❑	❑	❑	❑
HELP AND DOCUMENTATION				
Context-sensitive on-line help	■	■	■	■
Troubleshooting guide	■	■	■	
Quick-start booklet	■	■	■	
Keyboard template	■	■	■	■
Reference card	■	■	■	■
Toll-free telephone support	■	■	■	■
Tutorial program	❑	■	■	■
Command table	■			
THIRD-PARTY SOFTWARE				
SideKick	■	❑	■	■
Sideways	■	■	■ (built-in)	■ (built-in)
SQZ	■	■	❑	

ENDS

mean different things at different places in the menus. The setting sheets in 2.2 are a step in the right direction, but the menu structure really needs to be revamped.

FIRST-CLASS SUPPORT

Lotus should be congratulated for starting up the Lotus PROMPT HotLine, a 24-hour, seven-day, toll-free support number. I tried the hotline at various hours, not surprisingly, it tended to be busiest during business hours. But being able to call and get help at 3 p.m. on a Saturday afternoon is a feature that would be nice to see be-

come an industry standard. Both releases come with an initial six months of free hot-line support.

If you're a *DeskMate* user, you should know that in August, Lotus made another move to increase market share by announcing, with Tandy, the *Lotus Spreadsheet for DeskMate*. Based on the technology of *1-2-3* 2.01, it makes use of the graphical user interface of Tandy's *Desk-Mate* environment. The program's feature set offers most of *1-2-3*'s functionality, but does not support macros, add-ins, or expanded memory. Worksheet files are

WHERE TO FIND RELEASE 3'S NEW FEATURES

Many new features of *Lotus 1-2-3*, Release 3, are located under the Worksheet and Print headings of the main menu. You'll find the new multiple-spreadsheet commands under Worksheet, and the Print menu offers the package's improved output design.

These menu trees show all of the commands under the Worksheet and Print headings. Commands new to Release 3 are highlighted.

PRINT COMMANDS

Print

Printer · File · Encoded · Suspend · Resume · Cancel · Quit

Range · Line · Page · Options · Clear · Align · Go · Image · Sample · Hold · Quit

All · Range · Borders · Format · Image · Device · Current · Named-Graph

Header · Footer · Margins · Borders · Setup · Pg-Length · Other · Name · Advanced · Quit

Left · Right · Top · Bottom · None · Columns · Rows · Frame · No-Frame · Use · Create · Delete · Reset · Table

As-Displayed · Cell-Formulas · Formatted · Unformatted · Blank-Header

Suppress · Print

Device · Layout · Fonts · Color · Image · Priority · AutoLf · Wait · Quit

Name · Interface · 1 2 3 4 5 6 7 8 · Yes No · No Yes

1 2 3 4 5 6 7 8 9 · Default · High · Low

1 2 3 4 5 6 7 8 9 · 1 2 3 4 5 6 7 8 9 · Rotate · Image-Sz · Density · Quit

Pitch · Line-Spacing · Orientation · Quit · No Yes · Final · Draft

Portrait · Landscape · Margin-Fill · Length-Fill · Reshape

Standard · Compressed · Range · Header/Footer · Border · Frame · Quit

Standard · Compressed · Expanded · 1 2 3 4 5 6 7 8

WORKSHEET COMMANDS

Worksheet

Global | Insert | Delete | Column | Erase | Titles | Window | Status | Page | Hide

Hide → Enable | Disable

Insert → Column | Row | Sheet
 Sheet → Before | After
 → Column | Row | Sheet | File

Delete → No | Yes
 → No | Yes

Column → Set-Width | Reset-Width | Hide | Display | Column-Range
 Column-Range → Set-Width | Reset-Width

Erase → No | Yes

Titles → Both | Horizontal | Vertical | Clear

Window → Horizontal | Vertical | Sync | Unsync | Clear | Map | Perspective | Graph | Display
 Map → Enable | Disable
 Display → 1 | 2

Format | Label | Col-Width | Prot | Zero | Recalc | Default | Group

Group → Disable | Enable

Prot → Enable | Disable

Zero → No | Yes | Label

Recalc → Natural | Columnwise | Rowwise | Automatic | Manual | Iteration

Default → Printer | Dir | Status | Update | Other | Graph | Temp | Ext | Autoexec | Quit
 Update → Last | Save | Yes | No
 Graph → Columnwise | Rowwise | Metafile | PIC | Quit

Label → Left | Right | Center

Format → Fixed | Sci | Currency | , | General +/ | Percent | Date | Text | Hidden | Other
 Date → 1 2 3 4 5 | Time
 Time → 1 2 3 4
 Other → Automatic | Color | Label | Parentheses
 Automatic → Negative | Reset
 Parentheses → Yes | No

Printer → Interface | AutoLf | Left | Right | Top | Bottom | Pg-Length | Wait | Setup | Name | Quit
 Interface → Yes | No
 → 1 2 3 4 5 6 7 8 9
 → 1 2 3 4 5 6 7 8 9

Wait → No | Yes

Other → International | Help | Clock | Undo | Beep
 Help → Instant | Removable
 Clock → Standard | International | None | Clock | Filename
 Undo → Enable | Disable
 Beep → Yes | No

International → Punctuation | Currency | Date | Time | Negative | Release 2 | File-Translation | Quit
 Punctuation → A B C D E F G H
 Currency → A B C D
 Date → A B C D
 Negative → Prefix | Suffix
 Release 2 → Parentheses | Sign
 File-Translation → LICS | ASCII
 → Country | International

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PC LABS — PERFORMANCE TESTS: THE NEW LOTUS 1-2-3s

Lotus 1-2-3, Release 2.2, is slower than the Release 2.01 package you're probably using today. Lotus 1-2-3, Release 3, is slower still. That's the price you pay for the two upgrades' impressive array of new features.

Mathematical Worksheet Recalculation — Elapsed Time (seconds)

Mathematical Worksheet Recalculation reports the time taken to calculate a Lotus 1-2-3 2.01 worksheet with 1,950 mathematical entries and 494 text cells. Lower times indicate more-efficient implementation of standard spreadsheet functions.

126.57	113.17	68.43	59.83	46.98

Loan Recalculation — Elapsed Time (seconds)

The Loan Recalculation test worksheet calculates the monthly payment and displays the amortization schedule for a ten-year loan based on any given loan principal. This test is a typical spreadsheet application.

4.12	3.31	1.96	1.52	3.02

Internal Rate of Return Recalculation — Elapsed Time (seconds)
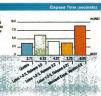
Internal Rate of Return Recalculation tests the Net Present Value and Internal Rate of Return functions. These computation-intensive formulas indicate the efficiency of a program's calculation and Internal Rate of Return algorithms.

6.12	3.8	1.73	2.43	2.86

Save to Disk — Elapsed Time (seconds)

The Save to Disk test measures how long it takes the spreadsheet program to save the Mathematical Worksheet Recalculation test file to disk, using the product's native file format.

3.71	6.13	4.27	3.75	8.05

Quattro · Lotus 1-2-3 Release 3.0 · Lotus 1-2-3 Release 2.2 · Lotus 1-2-3 Release 2.01 · Microsoft Excel Version 2.1

The Wait is Over.

PC LABS

PERFORMANCE TESTS: THE NEW LOTUS 1-2-3s

Load from Disk

The **Load from Disk** test measures how long it takes the spreadsheet program to load the Mathematical Worksheet Recalculation test file from disk, using the product's native file format.

Elapsed Time (seconds)

WORST

30.0

22.5

15.0

7.5

0

| 4.43 | 18.07 | 6.05 | 6.02 | 29.51 |

BEST

Disk Space

Disk Space reports the size of the Mathematical Worksheet Recalculation file when the spreadsheet program saves it to disk in the program's native file format. A smaller number here is better, leaving room for more or bigger files on the same disk.

File Size (kilobytes)

WORST

84.0

63.0

42.0

21.0

0

| 81.0 | 83.0 | 83.0 | 81.0 | 79.0 |

BEST

Quattro
Lotus 1-2-3, Release 3.0
Lotus 1-2-3, Release 2.2
Lotus 1-2-3, Release 2.01
Microsoft Excel, Version 2.0

PC LABS

PERFORMANCE TESTS: COMPOSITE VIEW

Will you sacrifice speed if you upgrade to *Lotus 1-2-3*, Release 2.2 or Release 3.0? The answer depends on what you've been using thus far.

PC Labs tested *Lotus 1-2-3* 2.2 and 3.0 on an 8-MHz IBM PC AT running DOS 3.3 and equipped with a 30MB hard disk, a math coprocessor, and 1MB of extended memory (Release 3.0 requires at least 384K extended memory). The results were compared against the performance of *Lotus 1-2-3* 2.01, Borland's *Quattro*. and *Microsoft Excel*, all of which we had previously tested (*PC Magazine*, November 15, 1988) using 640K conventional memory.

These packages offer various kinds of automatic or intelligent recalculation features. We restricted our tests to manual recalculation. You'll certainly see slower recalculations with Release 3.0 than with 2.01 or 2.2, but *Quattro* is slower on recalcs than any other package tested. *Excel* is fastest on straight math calculations, coming in third on the other two recalculation tests.

When you're saving to disk, you may notice a lag in *Lotus 1-2-3* 3.0 compared with 2.01 and 2.2, but you'll take even more time to save *Excel* files. Likewise, *Excel* trailed behind all others in loading from disk (we used a Lotus .WK1 file in testing, so *Excel*'s overhead shows up here). *Quattro* is fastest both in saving and in loading a file from disk. Among the three versions of *Lotus 1-2-3*, 2.01 remains the fastest at loading a file, performing significantly better than Release 3.0.

The moral is: If you're going to upgrade to Release 3.0 or 2.2, do it for the new features, not for any speed improvements. If you do a lot of recalculations, don't do them manually, and do expect to see some sluggishness.

Relative Times
(*Lotus 1-2-3*, Release 2.01 = 100)

300
240
180
120
60
0

Load from Disk
Save to Disk
Internal Rate of Return Recalculation
Loan Recalculation
Mathematical Worksheet Recalculation

Quattro
Lotus 1-2-3, Release 3.0
Lotus 1-2-3, Release 2.2
Lotus 1-2-3, Release 2.01
Microsoft Excel, Version 2.0
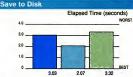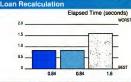
PERFORMANCE TESTS: THE NEW LOTUS 1-2-3s ON A COMPAQ DESKPRO 386/25

PC LABS

Most users of Release 3.0 won't be satisfied running it on slow hardware, which might explain why Lotus has publicized high-end hardware requirements. With this in mind, PC Labs retested Release 3.0, along with Release 2.2, on a Compaq Deskpro 386/25 under DOS. We also tested Release 3.0 under OS/2.
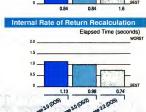
These tests confirmed two important points: Release 3.0 does run under OS/2, and indeed you will see much faster processing on a 386. Just be sure that your 386 has a large enough hard disk if you're using OS/2; we needed almost twice the space that we needed when running under DOS.

Mathematical Worksheet Recalculation

Elapsed Time (seconds)

WORST

32.0
24.0
16.0
8.0
0

BEST

31.93   31.47   22.0

Save to Disk

Elapsed Time (seconds)

WORST

4.0
3.0
2.0
1.0
0

BEST

3.03   2.07   3.32

Loan Recalculation

Elapsed Time (seconds)

WORST

2.0
1.5
1.0
0.5
0

BEST

0.84   0.84   1.6

Load from Disk

Elapsed Time (seconds)

WORST

6.0
4.5
3.0
1.5
0

BEST

4.53   3.75   2.0

Internal Rate of Return Recalculation

Elapsed Time (seconds)

WORST

2.0
1.5
1.0
0.5
0

BEST

1.13   0.98   0.74

Disk Space

File Size (kilobytes)

WORST

80.0
60.0
40.0
20.0
0

BEST

83.0   83.0   83.0

Lotus 1-2-3, Release 3.0 (DOS)
Lotus 1-2-3, Release 3.0 (OS/2)
Lotus 1-2-3, Release 2.2 (DOS)

Lotus 1-2-3, Release 3.0 (DOS)
Lotus 1-2-3, Release 3.0 (OS/2)
Lotus 1-2-3, Release 2.2 (DOS)

ENDS

saved in .WK1 format. *Lotus Spreadsheet for DeskMate*, which will have a list price of $219.95, is due to ship sometime before the end of the year.
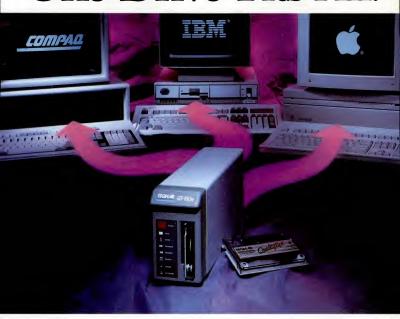
When it comes to 2.2 and Release 3, Lotus's upgrade policies are extremely reasonable. If you bought 2.01 on or after September 6, 1988, upgrading to either 2.2 or 3 is free until the end of 1989. After that, the upgrade price will be $150. If you bought a version of *1-2-3* previous to the September date, the upgrade to either 2.2 or 3 is $150. If you bought *Always* separately, the upgrade to 2.2 is $90.

All in all, the upgrade is worth the price. The question is which one to buy. If you don't have the hardware to run Release 3, the choice is easy: 2.2. If you have the hardware already and you want OS/2 capability, go with Release 3. Short of these factors, you may have a problem deciding.

Ultimately, as Lotus points out, the two releases are built around different design philosophies. Release 2.2 is about speed and small size and being able to run on an 8088. Release 3 is about power, features, taking full advantage of your hardware,

and being able to run on different hardware platforms (eventually). Either way, the revisions are welcome and overdue. The people at Lotus know better than anyone else that options in the spreadsheet marketplace have never been better. The two new releases of *1-2-3* represent Lotus's attempt to keep its 5 million users loyal, and it's likely that because of the easy, inexpensive upgrade path, a majority of them will remain Lotus loyalists. ■

M. David Stone is a contributing editor of PC Magazine.

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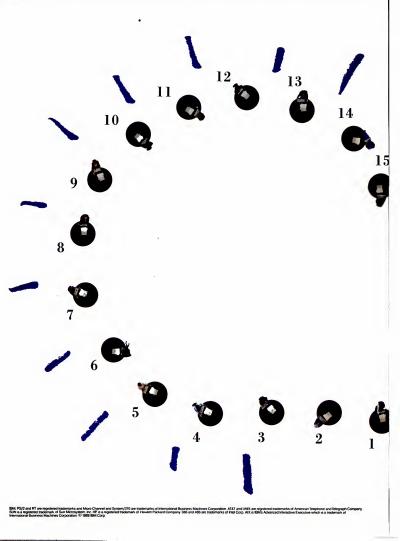
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Digitizing Tablets
Pointing the Way to Easier Input

**Technological advances
have made digitizing tablets
an increasingly attractive
alternate input option—and
not just for CAD users.
PC Labs evaluates 24 models
from 15 manufacturers.**

by Winn L. Rosch

Sorry, Miss Manners. Pointing may be impolite, but it sure is efficient. Whether you want to locate a person in a crowd or a dot on a blueprint, pointing to it can save a lot of talking or typing.

That's the whole point of digitizing tablets. Put a pen or cursor in your hand, and just by pointing you can quickly and accurately create or trace drawings, blueprints, or original art. And despite Miss Manners's admonitions, pointing is the most natural way of expressing yourself. A digitizing tablet is as familiar and easy to master as a pen and paper.

Digitizing tablet is an amazingly straightforward term. The term *digitizing* refers to the process of converting positions on a plane (Cartesian *x*- and *y*-coordinates) into digital values that can be used by applications like CAD, illustration, and paint programs. A *tablet* is the physical embodiment of the device and is also its metaphor. It resembles the classic paper drawing tablet, a flat surface

PHOTOGRAPHY: JOHN MUEGE

upon which you can sketch.

Underneath its surface, however, the digitizing tablet is a complex electronic miracle that can pinpoint a specific location with an accuracy as fine as .001 inch.

BEYOND THE MOUSE

Tablets are distinguished from mice in two ways. In its native mode of operation, the tablet indicates absolute locations—that is, you point to a particular location on the tablet. Later, by putting the tablet's pen or cursor back in the same location, you return to the same on-screen point. In effect, the point is logically fixed to its location on the tablet.

A mouse is a relative pointing device. It indicates distances between locations rather than absolute locations. If you roll a mouse across a pad, lift it up, and move it back to its original location, it usually won't indicate the same on-screen point.

Your preference depends on how you work. If you draw while watching the screen, relative locations may be all you need. If you want to trace an existing drawing, however, absolute positioning is a must. You need to make the on-screen (and in-file) digital image an exact representation of the paper artwork. Tape a blueprint to a tablet and you can transfer every one of its lines into your drafting program.

The absolute/relative distinction between tablets and mice is blurring. Most of today's tablets include mouse drivers that allow them to emulate some type of mouse (Microsoft's is the most popular emulation). Equipped with an emulation, the tablet becomes more versatile than the mouse, because it can deliver both absolute and relative positioning.

Tablets also differ from mice in the way you use them. Typically, tablets give you a choice of using a pen (or stylus) or a cursor (sometimes called a *puck*). A pen makes using a tablet almost indistinguishable from ordinary drawing. In fact, you can draw on paper with an inked pen as you digitize information for your applications. Only the pen's cable will remind you that you're connected to your computer. An increasing number of tablets even eliminate the need for this umbilical.

On the other hand, you manipulate a tablet cursor the same way you do a mouse. A cursor is a hand-size pointing device with 1 to 16 buttons on top and a reticle with cross hairs that allows you to indicate exactly a particular point that you want to digitize. Compared with mice,

ALTERNATE INPUT: A WEALTH OF OPTIONS

MICE
Price: $80 to $180

Mice continue to proliferate in the workplace, and as graphical user interfaces arrive, even more mice will be sold. They are by far the most widely supported of input devices. Mouse technology ranges from mechanized balls and rollers to optical photosensors; however, the technology behind a mouse doesn't make much difference in its functionality.

Companies are now trying to outperform each other in resolution; 200 to 300 dots per inch is the average range. The higher the resolution, the smaller the work space needed to move the mouse around. Some mice now require an area of just 1 by 2 inches.

A variation on the mouse theme is the ALPS Isopoint, a rolling bar that can move your cursor in any direction, built into the base of a keyboard. The Isopoint could become a big success on laptops, especially if graphical user interfaces start appearing on them.

Advantages:
Inexpensive

Most widely supported alternate input devices

Familiar to most PC users

The higher the resolution, the smaller the necessary work space

Disadvantages:
Low resolution compared with that of tablets

The higher the resolution, the faster the scroll, which makes pinpointing an area difficult

DIGITIZING TABLETS
Price: $429 to $2,000 or more

Tablets generally resemble a sketch pad upon which you can draw with a pen or a mouselike cursor. Some tablets offer primitive character recognition to let you input data by writing it on the tablet, but their tested accuracy is less than optimal. Models with cordless pointing devices (by Kurta and Wacom) give you great freedom in drawing.

Primarily found on the desks of artists and CAD users, tablets can also be used by anyone who wants to save keystrokes by having all of an application's commands laid out in one place. Templates for *PageMaker*, *Microsoft Windows* and other menu-intensive applications are leading this trend.

Tablets range in dimension from book size all the way up to drafting-table size. Prices increase proportionally, and the largest models are usually found in architectural and engineering firms, not in the possession of graphic artists.

Advantages:
Extremely high resolution (1,000 dots per inch and more)

The ability to unnest menus, putting the entire menu tree under your control

Disadvantages:
Relatively expensive, especially when they are used primarily as menu time-savers

The higher the resolution, the larger the footprint

Not as widely supported by software as mice, making usefulness questionable for some applications

TRACK-BALLS
Price: $95 to $169

A trackball looks very much like a cue ball set into a base. It lets you input data in either two or three dimensions and move the cursor around the screen very quickly. Unlike a mouse, a trackball doesn't run out of desk space or need to be repositioned.

Logitech's new $149 TrackMan combines a small thumb-operated trackball with three mouse-style buttons to provide the best of both technologies.

Advantages:

Small footprint
Use mouse emulators, so have wide support

Disadvantages:

Unfamiliar to majority of PC users
Relatively low resolution

TOUCH SCREENS
Price: $230 to $995

Touch screens let you touch a menu selection with your finger to activate a function. Most screens use one of two technologies: either your finger interrupts infrared light beams crisscrossing the screen surface, or it closes an on-screen circuit. Touch screens are excellent for public information services and for training purposes in any number of applications. The leading manufacturer is Hewlett-Packard.

Advantages:

Good training tools
In many cases, resolution is completely dependent on the pointing device (a pen will have greater accuracy than a finger)

Disadvantages:

Environment-sensitive
The tendency to lose their sensitivity as screen coatings wear off
Touching the screen becomes tiring at a PC set up with the screen at eye level
Fingerprints can cloud the screen and create glare

LIGHT PENS
Price: $145 to $200

Light pens can be used like touch screens, allowing you to point to a function on the screen. You can also use them like tablet pens and actually draw on the screen. All light pens plug into the graphics adapter and send electron beams to the adapter to pinpoint the pen's location.

Advantages:

Flexible, can be used either as touch screens or tablet pens
Good training tools

Disadvantages:

Not widely supported by software
As with touch screens, you must lift your arm to the screen
Most light pens also have a cord to contend with
To get pixel-point resolution, you must include special adapter cards

---

cursors are more accurate and less comfortable to use. They are generally gripped with your fingers extended as if you were picking up some kind of insect that threatened to crawl up your leg. In general, cursor designs could use some rethinking.

DISTINGUISHING DIGITIZERS

While this sampling—some 24 tablets—may seem diverse, it represents only a slice of the tablet market. Current products range from those the size of paperback books to full drafting tables. They differ in the accuracy and resolution they deliver and in the speed at which they transmit information. At heart, they use a variety of technologies to determine the coordinates of their pointing devices. And the pointing devices themselves have their own spectrum of differences.

Size is perhaps the least important dimension of digitizing tablets. Many manufacturers offer tablets identical in features except for the drawing area. A product line may embrace a range from 12-by-12 to 36-by-48 inches or more. How much space you need depends on the application you plan to use, the images you wish to digitize, and how much you can spend. To bring this survey down to size, PC Labs sampled products that were as close as possible to two standard sizes, the popular and inexpensive 12- by 12-inch tablets and 12- by 18-inch models. Larger-size tablets in a manufacturer's line can generally be judged by their standard-size kin.

One interesting product not quite ready in time for evaluation is the Personal Writer 10SL, a new arrival from the Macintosh arena. The Personal Writer includes a 2.5-inch-wide miniature keyboard and screen right on the tablet's face, and since it can emulate your keyboard and handle pulldown menus, it is compatible with any program that runs under DOS, PC Labs sampled. The Personal Writer can also record and store hundreds of macros for any application.

Another model, the Personal Writer 15SL, offers handwriting recognition that can convert your scrawl into plain, bold, or italic type in any point size. The Personal Writers are available in a range of sizes from 12-by-12 to 42-by-60 inches. Prices start at $799. Contact Personal Writer, 1900 Avenue of the Stars, #2870, Los Angeles, CA 90067; (213) 556-1001.

THE SIZE QUESTION

Bigger means more precise, because tablet precision is measured by the number of

HOW DIGITIZING TABLETS WORK

ELECTROMAGNETIC TECHNOLOGY

Electromagnetic sensing is the most common technology used in tablets. Like radio direction finders used in navigation, these tablets use electromagnetic fields—radio waves—to zero in on a precise location.

The system is comprised of two parts: an antenne grid on the tablet and a complementary antenne coil in the pointing device. The grid is a screenlike, two-dimensional array of wires or conductive traces spaced from .1 to .5 inch apart. The coil is a loop of wire located either inside a pen or visibly encircling the reticle of a cursor.

Typically, the coil emits a brief pulse of radio waves, which is received by the grid. The signal induced in the grid will be strongest in the perpendicular pair of wires that are closest to the coil, giving the tablet a rough indication of the location of the coil. The fine position of the coil is determined by the delay between the transmission and reception of its signal. If the coil is directly over a grid trace, the delay is minimal; if it's midway between two traces, the delay stretches to its maximum.
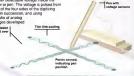
Some tablets reverse this procedure, using the tablet grid as a transmitter and the pointer coil as a receiver, but this arrangement is more difficult to shield and is more sensitive to noise and interference.

Transmitting wave

Antenne coil inside pen

Strongest signal

Weakest signal

SONIC TECHNOLOGY

The technology of Science Accessories' Grafbar GP-7 Mark I could be described as triangulated bat echolocation. The system's pointing devices emit a sharp click (like bats do). A pair of separated microphones—bat ears—listen for the noise, filtering out all sounds except those in the range from 65 to 75 kHz. The distance from pointing device to microphone is easily calculated using the speed of sound, and through triangulation the x- and y-coordinates of the pointing device's position can be determined.

Science Accessories' cursors use piezoelectric elements to generate the sonic signals. The pens use spark gaps. Both are triggered by a 600-volt pulse. The sound emitted by the devices is inaudible unless you hold the pen or cursor up to your ear.

Coordinates calculated via sound waves

Sound waves

Device— clicking inaudibly

Greatest usable area of digitizers

RESISTIVE DECODING TECHNOLOGY

Resistive decoding technology substitutes a thin film coating in place of the wire grid used in more-conventional tablets. Although the indium-tin oxide coating is hidden inside the opaque tablets, it's vital to the clear ones—the compound is almost completely transparent itself. Look through a Scriptel RDT-series tablet and all you can see is a faint pattern that seems as if it were inside the glass.

The resistive decoding system works by creating a voltage gradient across the film. This voltage induces another detectable voltage inside the cursor or pen. The voltage is pulsed from each of the four sides of the digitizing area in succession, and using the ratio of analog voltages developed from each pulse inside the pointing device, the system detects the location of the pointing device. The analog ratios are converted to digital form and are then processed by a patterned error-correction circuit to compensate for nonlinearities in the system.

The resistive decoding system promises the same resolution and accuracy as most conventional electromagnetic tablets—1,000 points per inch with a 0.01-inch accuracy. The maximum drawing speed of the system is limited by the electronics of the pad.

Pen with voltage sensors

Thin film coating

Clear tablet placed over image

Points sensed, indicating pen position

FINANCIAL POWER MADE SIMPLE

lines that can be resolved within an inch. A 48-inch tablet will resolve four times as many points as a similar 12-inch one. The bigger tablet will also be more tiring to use—you may have to stretch across the whole surface to draw. Then again, applications often allow you to set the size of the digitizing area. You can set your coarse drawing on a small section of the tablet and use the entire tablet for detail work.

The useful space on a tablet varies with several outside factors. Both the application you run and the tablet driver you use control how much of the surface is put to work. For example, AutoCAD provides a TABLET CFG command that allows you to shrink the tablet space actually devoted to screen manipulation and to define portions of the tablet as menu areas. To give a general indication of the integration of each tablet with typical application programs, PC Labs measured the default tablet area devoted to AutoCAD drawing (as opposed to menu activation) before configuration.

If you're drawing freehand, speed may be the most important digitization issue to you. A tablet must be fast enough to follow the quickest motions of your hand. The points-per-second figures are a general indication of the speed at which a device relays coordinates to the applications with which it communicates. However, this speed is dependent on the communications rate of the connection between tablet and host (you'll want to use the fastest data rate possible—serial speeds of 9,600 bits per second or quicker).

The speed that is reported by the manufacturer of a tablet does not always accurately represent the performance you really get, so PC Labs tested drawing speed under actual-use conditions—drawing lines and boxes as rapidly as possible in AutoCAD—and also evaluated performance subjectively.

Two factors are important for determining whether you can use a given tablet at all: software and emulations. The software that comes with a tablet may include specific drivers to allow the tablet to work with specific applications. Mouse support usually takes the form of a driver. Many applications already have built-in support for tablets. With these programs, it's important that the tablet you choose works like one that your favorite applications know. Most tablets can emulate one or another of the more popular data formats used by digitizing tablets—for instance, that of the Summagraphics MM Digitizer

Series tablets. Make sure that the tablet you choose emulates something your software supports.

POINTING DEVICES

The pointing devices that accompany digitizing tablets are myriad. From a usefulness and versatility standpoint, however, the most important distinguishing characteristic we found was cordlessness. Most pointing devices must be tethered to the tablet by a cable that is used to communicate position information to the tablet electronics. Two tablets reviewed here—Kurta and Wacom products—have cordless devices. In testing, this proved a great convenience. Not only was there no cable to tangle, snarl, and resist our drawing efforts, but cordless operation also allowed us to switch between using a pen and a cursor instantly.

Of course, cordlessness can be a problem, too. Cordless pens and cursors can be misplaced—accidentally or otherwise—just as quickly as Bic pens. Not that a cord will prevent a thief from littering the pointing device (and at prices up to $250, the prospect may be tempting), but the cord does serve as a reminder not to put the pen in your pocket and stroll off. The cord can also prevent an expensive pen from dropping to the floor and being trod upon.

The shape and feel of a cursor or pen is the most subjective feature of any tablet. In general, a pen feels like a bloated ballpoint, not unlike the typical technical pen. The cursor is a hunk of plastic that provides a place for buttons. The number of buttons you need on a cursor depends mostly on how many your favored applica-

tion supports; a 16-button cursor will mean that you might rarely have to go back to your keyboard to select functions, but you'll probably have to squint at the cursor to figure out which button does what.

Pens differ in the number of buttons they offer, too. In general, all pens give at least one switch that's activated by pressing down on the point, the tip-switch. A second button (and sometimes a third) on the side of the pen near the tip may also be available. How worthwhile additional buttons are depends on the software you use.

Sometimes pens are distinguished from styli in that the latter don't contain ink supplies. With few exceptions (notably the ZedPEN), pens can be equipped with dummy inkless cartridges to make them into styli. Pen-shaped pointing devices are uniformly described as pens in this article.

A new kind of pen, the pressure pen, is rapidly becoming popular. Instead of merely indicating on or off, the pressure pen sends out a digital value corresponding to the force applied to the pen tip. This force can then be used by an application to indicate the width, weight, or color of a line drawn in that application, a feature particularly useful in freehand sketching. Pressure pens vary in the range of forces they can detect and the number of pressure levels they can digitize (typically from 64 to 256).

All in all, you'll find more variety among tablets than among just about any other kind of input peripheral that you can connect to your computer. Which one is best for you depends not only on the quality of the product, but on your preferences and applications as well. Here, in alphabetical order by company name, are evaluations of 24 models.

ALTEK CORP.
Datatab ACT1212
by Frank Bican

As a manufacturer of digitizing systems for over 18 years, ALTEK has been a leading supplier of tablets to military and government agencies. Given that such a time span in any computer-related industry is epic, you might expect old-world craftsmanship. Indeed, the Datatab ACT1212 gives you that—perhaps a bit more of it than you want to deal with.

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boards, ALTEK's model is built out of such earthy commodities as oak and steel. The end result is a mixed blessing of surprisingly detailed workmanship and just plain antiquity.

The tablet itself is built around a mitered oak framework covered on top and bottom with Formica veneers, and the edges display their woodgrain for all the world to see. Handsome, perhaps, but this construction would appear to be an invitation to dimensional instability in environments with fluctuating humidity.

Buried within is the gridwork that provides this electromagnetic tablet with accuracy to within 0.003 inch—higher than you could ever be expected to match with a hand-held pen or cursor, of which several are available.

The work space itself is far larger than the active area, measuring 25.2 by 19.2 inches. If you have a huge desktop, you'll relish the added space for pens, cursors, and rulers. For many, though, the ACT1212 may devour too much real estate for its capabilities.

The working surface of the ACT1212 resembles a Formica countertop, with nothing to clutter it but a logo in the upper-right corner. There is no indication of the boundaries of the active area, which measures 19.3 by 13.4 inches (judging by the cursor's proximity LEDs, far larger than the manufacturer's claim of 12 by 12 inch-

es. As with most of the other tablets, though, this one's default workspace, when used with *AutoCAD*, measures a smaller 8.5 by 10 inches.

Although a stylus (which can double as a ballpoint pen) is available, more useful are the three available cursors (2-, 4-, and 16-button). Each is precisely machined out of optically clear plastic, with a generous 1.5-inch cross-hair reticle.

Built around a Z88 microprocessor, the tablet's controller board is mounted in a 1-inch-deep steel box that is attached to the bottom of the tablet. Around the perimeter of the box are connectors for the serial-port cable, tablet cable, power supply, and pointing device.

Setting up the ACT1212 at PC Labs proved to be a rather frustrating experience. If the factory DIP switch settings don't work (they didn't for us), you'll have to hunt around for a Phillips screwdriver to remove the bottom panel from the controller box. Next, open the manual and discover just how unclear documentation can be. Finally, call ALTEK's technical support; they'll help you configure it.

But that's just the start. There is a five-selection soft-key menu that must be mounted just outside the lower-left corner of the active area. For this, the manual recommends attaching a terminal and marking the 0,0 *x*- and *y*-coordinates. If you don't have a terminal readily available, you can use one of the cursors and mark off the active area, which is indicated by the cursor's proximity LED. Once the proper area is located, remove the backing from the paper label and mount it on the board. Given this product's list price of around $2,000, you would expect the manufacturer to measure the active area and mount the label for you.

Testing with *AutoCAD* revealed less-

than-perfect performance. Coordinate output was quite slow, resulting in a jumpy on-screen image, and button clicks were commonly missed if the cursor or pen was moving quickly. The ALTEK tablet was one of the few that exhibited signs of external interference. With the pen resting on the tablet, the image jumped around noticeably, perhaps affected by another tablet set up some 6 feet away.

All that hand craftsmanship translates into high costs, and considering that a minimal configuration (tablet, controller, and pen) will cost $2,005, the ACT1212 is overpriced in relation to its equally capable competitors.

CALCOMP

DrawingBoard 2300 Model 23120 CalComp 2500 Series Model 25120

by Winn L. Rosch

CalComp's DrawingBoard 2300 and 2500 Series tablets are a picture of evolution in progress. The 2500 Series is the early step, the former quintessence of development suddenly overshadowed by an even more promising cousin, the DrawingBoard 2300.

Although CalComp has been known as a supplier of PC peripherals for about as long as there have been PCs, these tablets hark back further—to 1971, the year Talos Systems was formed. That company introduced its first electrostatic tablet in 1974 and became part of CalComp in 1980.

In the current product line, the DrawingBoard 2300 and the 2500 Series are distinguished as low-priced, high-performance models, respectively. But the drawbacks of the 2300 line are so scant as to make it a top choice PC tablet; the 2500s, on the other hand, are archaic curiosities.

While functionally similar and sharing the same pointing devices, the two tablets are aesthetically, ergonomically, and operationally distinct. The 2500 incorporates a number of good ideas that are fine-tuned in the 2300. Two 2500 models are available, the $915 Model 25120 with a 12- by 12-inch digitizing area, and the $1,275 Model 25180 with a 12- by 18-inch digitizing

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area. The 2300 series comes in three sizes, the 12- by 12-inch 23120 for $595; the 12- by 18-inch 23180 for $1,095; and the 18- by 24- inch 23240 for $2,495. We looked at the 12- by 12-inch models of each line.

The DrawingBoard 2300 Model 23120 proved to have its own elegance. It's hardly more than a flat square measuring 15 inches wide by 16 inches long; its wedge shape tapers up from half an inch to an inch and a half high, bottom to top. Its actual active area proved generous, measuring 12.25 by 12.25 inches. Beyond that, the 23120 adds a few refinements to tablet design.

It has pivoting retractable feet, allowing you to adjust the angle between its work surface and your desk by about 15 degrees. A transparent vinyl cover sheet is provided to protect and hold down templates or drawings you might want to trace. Attached by snaps, it covers not only the drawing area but also an inactive bottom inch and a half of the tablet. A small trough at the top of the pad provides a convenient resting place for the CalComp pen. An LED located to the right of the trough indicates a number of system operation and setup functions. Overall, it's lightweight (about 4 pounds) and solid.

Setup controls are integrated into the 2300's digitizing functions so that communications parameters can be set without switches. Instead, you need only point the cursor at a menu area above the active digitizing area. The menu is part of the plastic cover of the tablet. Changes are made in a straightforward fashion—putting the cursor cross hairs (or pen-tip) over a designated menu area causes the LED indicator to glow, signalling "on." Each function is toggled on or off by pressing down on a cursor button or pen tip. There is one default set of parameters, and two others can be stored in and retrieved from nonvolatile memory.

2500 SERIES

The 2500 Series bears only a family resemblance to the 2300. The 12- by 12-inch Model 25120 is thicker and heavier (about 7.5 pounds) than the 23120. Moreover, it uses a different setup arrangement and features a darker gray highlight to distinguish its active digitizing area, which was exactly the advertised size. The 25120 tablet itself is a basic wedge, 14.75 inches wide by 15.75 inches long, tapering down from 2.5 to 0.6 inches. A 4.25-inch inset about an inch deep near the middle of either side provides a convenient grip for picking up

CalComp's DrawingBoard 2300 (bottom) and 2500 Series (top) offer high performance but opposite growth-potential. At $915, the 2500 is a solid performer but a technological dead end: the 2300 ($595) is newer, sleeker, and provides room for growth.

the tablet. The top of the tablet is plastic; the base plate is aluminum. This is a sturdy product, for heavy-duty use.

The operating parameters of the 25120 are set through a menu at the top of the digitizing area, as with the 23120, but the legends identifying the functions of individual areas are screened onto the tablet itself. Functionally, they differ in that they're arranged logically into five banks that must be individually set using a complex but easy-to-learn configuration ritual. Again, they will likely need to be set only once—the values set are stored in nonvolatile memory.

While the price of the 23120 includes its power supply, a serial cable with a 9-pin adapter for ATs, and your choice of a pen and 4-button cursor or a 16-button cursor, the 25120 comes without a pointing device but with a serial cable ending in your choice of a 25-pin or 9-pin D-shell connector. The 9-to-25-pin adapter of the 23120 proved a mixed blessing—the one provided with the evaluation unit had nuts on the end of the securing screws, preventing its proper insertion.

The CalComp pen, $92 if purchased separately, resembles a fat ballpoint almost half an inch in diameter at its widest. For a better grip, the last inch and a half of

the tapering semiconical tip is fluted. It is easy to hold and manipulate. Its tip twists off so that you can replace the 3.25-inch cartridge with a foreshortened conventional ballpoint cartridge.' Only a tip-switch was available on the pen delivered with the evaluation system, although units with side switches are also available from Cal-Comp. The DrawingBoard 2300 is also compatible with an optional $595 pressure pen that distinguishes 256 levels of force on the pen tip, using an external processor in an auxiliary box.

The CalComp cursor is basically a rectangular lump (0.6 by 2.25 by 3.75 inches (HWD)) with a 1.5-inch extension for the triangular paddle and its cross-hair reticle. Instead of being centered, the reticle sight is offset to the left, and the cross hairs form an X rather than the more usual +.

Two styles of 4-button cursors are available. We tested one with the chiclet pushbuttons arranged in a straight line; another cursor puts them in a diamond pattern. Either costs $218. A 16-button cursor is also available at a cost of $275. The bottoms of the CalComp cursors are simply made from slippery plastic (akin to Derlin or Teflon), with three raised pads to reduce friction.

The 2500 uses basically the same pointing devices as the 2300, with the exception of different connectors and cable lengths. While the 2300 uses DIN connectors at the ends of its 42-inch pointing device cables, the 51-inch 2500 Series pointing-device cables terminate in 15-pin D-shells.

As to proximity range, the 23120

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proved a bit more sensitive than the 25120. While the pen proximity necessary for detection measured 0.87 inch for both tablets, the 23120 could detect its cursor 1 inch away, the 25120 only 0.75 inch.

Software support from CalComp is scanty at best. Nothing is provided with the 2500 Series. The DrawingBoard 2300

includes a coupon good for your choice of template for one of the following applications: *AutoCAD*, *Cadkey*, *VersaCAD Design*, or *Microsoft Windows*. The *AutoCAD* and *Windows* templates also include special driver software. Included with the

three CAD templates are special small templates for the CalComp 16-button cursors.

Both the DrawingBoard 2300 and 2500 Series are compatible with applications that recognize the commands used by Cal-Comp 2000 Series or 9100 Series and Summagraphics MM Digitizer Series tablets. In addition, the documentation is an unusually good and provides in-depth descriptions of the data formats used by the tablets. The DrawingBoard 2300 carries a full five-year warranty. The 2500 warranty runs only one year.

The 2500 Series comes out ahead as far as accuracy and resolution are concerned, but not by enough to make a difference in most applications. It resolves up to 1,278 lines per inch with 0.015-inch accuracy. The DrawingBoard 2300 resolves up to 1,016 lines per inch with 0.025-inch accuracy. Either tablet outputs up to 150 points per second.

The CalComp 2500 Series tablets have all the qualities to make a decent tablet, but the DrawingBoard 2300 is so much better, particularly in its ergonomic design, that the 2500 Series may just be an evolutionary dead end. The CalComp line might not fare too badly with the DrawingBoard 2300 as its flagship.

TAKING ADVANTAGE OF TEMPLATES

A template puts menu selections on a tablet. It's usually in the form of a laminated plastic sheet that defines and identifies areas on the tablet that will elicit functions in an application. Move the pen or cursor into an area, click a button, and the specified function is carried out. It's that easy.

Templates end up making you watch the tablet and not the screen, and they shrink the area of the tablet that you can actually use for drawing—increasing speed and convenience, but trimming accuracy. Templates are most often used with CAD programs. In fact, *AutoCAD* includes its own template for tablet users. Many tablet makers offer templates for commonly used applications like *Microsoft Windows* and *PageMaker*, usually through a cou-

pon redeemable through Promontory Systems.

Formerly called AutoEase, Promontory Systems markets templates that enhance most popular CAD packages as well as *Microsoft Windows*, *Page-Maker*, and *Micrografx Designer*. Each Promontory template set comes complete with its own icon-based templates that will work with any tablet. Some companies, such as CalComp and Kurta, have already incorporated Promontory's line of products into their tablets. Others, like Pencept and Summagraphics, offer a coupon redeemable for your choice of template. For more information, contact Promontory Systems Inc., 1325 S. 800 East, Orem, UT 84058; (800) 748-4774, (801) 224-8833. ∎

SketchMaster

by Frank Bican

GTCO has been in the tablet business since 1975, a full six years before the first IBM PC hit the shelves. Many of its larger models are just too expensive for the general PC market, but its new SketchMaster tablet rates high on the affordability scale and offers commendable performance to boot.

The plain gray tablet measures 15.5 by 15.5 inches, so it shouldn't require you to give up too much desktop space. The lighter-gray active workspace measures 12.5 by 12.5 inches, but that's a bit misleading, because in reality, the electronic image space is slightly smaller, at 11.7 by 11.7 inches. When used with *AutoCAD*, the default workspace shrinks still more, to 9 by 10.3 inches. Still, these dimensions are larger than those of some of the more portly tablets we looked at.

Covering the work surface is a clear acetate overlay, glued permanently in place along the lower edge. Considerably thin-

Promontory Systems' AutoMASTER template set enhances *AutoCAD*, expanding its capabilities as an architectural design tool. The package comes with software and menu templates for everything from an overall residential or commercial plan all the way down to electronics schematics and mechanical fasteners within the walls.

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ner than the robust overlays on the Kurta and Houston Instrument tablets, it could prove to be difficult to replace when it inevitably becomes wrinkled or scratched.

On the back of the enclosure are RJ-11 telephone-type connectors for the pointing device and serial cables and a mere three DIP switches. The latter select 9,600 baud rates, ASCII/binary output, and odd/no parity. Needless to say, setup is a breeze.

Conspicuously absent is the usual power brick to drive the entire assembly. Instead, the tablet draws its power from the serial port. This should pose no problem for AT-class machines, but it could be a problem with older PCs and their anemic 63-watt power supplies. Then again, if you're running AutoCAD on an old 8088-based PC, you've already got enough problems to warrant buying a new computer before worrying about tablets.

Missing from our evaluation unit was a pen. In its place was a mail-in card for the latest version, as well as mail-in cards for AutoCAD, CadKey, VersaCAD Design, and Microsoft Windows templates, all at no additional charge. Perhaps not exactly the ticket for those who require instant gratification, but at least you have the chance to get the latest versions of all the peripherals, even though the package may have been sitting on your dealer's shelf for a while.

The four-button cursor included with

At $449, GTCO Corp.'s SketchMaster is a good buy, especially with the enclosed coupon for complimentary application software templates. It is an adequate performer, keeping up with rapid drawing movements with minimal breakup of the on-screen image.

the package proved just adequate. Its antenna coil has an opening of only about 0.1 inch and is obscured by cross hairs in the center. It is fastened into place with plastic film that's not exactly optically transparent. It proved considerably more difficult to use than it should have.

GTCO's manual for the SketchMaster is virtually nonexistent, totalling a scant six pages (one of which is devoted to the warranty). Admittedly, not much is needed to set it up, but there is actually more in-

formation in the README file on the AutoCAD/Windows driver diskette.

GTCO understands the tablet market and supplies a serial cable with a DB-9 connector for AT- or 386-class machines, the only ones truly suitable for CAD. For those occasions where a DB-25 connector is called for, GTCO also includes a 9- to 25-pin adapter.

For actually laying out a drawing with AutoCAD, the SketchMaster proved to be an adequate performer. There was some breakup of the vertical on-screen cross hair in the line-drawing function, but not enough to be bothersome. Quite unlike some of the other tablets, the SketchMaster was decidedly fast in keeping up with cursor motion and was not one to miss button-clicks when used in freehand drawing motions.

It may not be a model of perfection as tablets go, but the GTCO SketchMaster is certainly worth considering. In its 12- by 12-inch version, it retails for a reasonable $449, including pen, four-button cursor, and AutoCAD and Windows drivers. A 12-by 18-inch version is also available for $699, and while the extra space could prove useful, the price differential for nothing more than additional plastic seems a little out of line.

HEWLETT-PACKARD CORP.

HP SketchPro
by Frank Bican

Hewlett-Packard Corp. has been the darling of the engineering crowd for over 30 years, but its name really became a household word when the company started making the first affordable scientific calculators in the early 1970s. With a lineup of plotters of nearly every size, it would only be natural for the company to offer a tablet as well.

At a list-price of $599, the HP Sketch-Pro is moderately expensive, but if you're one who subscribes to the philosophy that you get what you pay for, you probably won't be disappointed. Where some manufacturers cheat by making everything optional, this one is a complete package—tablet, pen, cursor, and software.

Construction quality and ergonomics are strong points for the SketchPro. The very compact tablet (only 12.8 by 13.5 inches) has a gentle slope that makes prolonged use easy, and the rugged overlay covering the 11- by 11-inch workspace should resist all efforts to bend or scratch it. That's important, because it is securely glued into place and would be difficult to replace.

Along the top edge of the tablet is a row of 22 soft keys. Of these, 12 are predefined

The HP SketchPro, $599, provides the quality that you expect from Hewlett-Packard. It is comfortable to use, compact, and complete, offering not only software but also 22 soft keys to control cursor movement, aspect ratio, size, tracking velocity, and more.

DIGITIZING TABLETS: SUMMARY OF FEATURES

(Products listed in ascending price order)

The following glossary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as they occur in the table.

Pen The terms pen and stylus are basically synonymous; both devices resemble overweight ballpoint pens. A pen may have an ink cartridge to let users see on paper what they have drawn on the screen. Pens may also have one or more buttons that correspond to the Enter key or perform other functions.

Cursor Unlike the blinking geometric shape on your screen, a tablet cursor is a hand-held pointing device larger than a mouse, with from 1 to 16 buttons and a clear reticle with cross hairs to allow precise selection of points. It is best used for tracing a mechanical or architectural drawing and is not recommended for freehand drawing.

Proximity is a measurement of the maximum distance between the tablet and the pointing device at which the digitizer works. Tablets require a factor when bulky items are placed on a tablet for tracing. A distance of 0.25 inch is acceptable; 1 inch is excellent.

Template A template is used on the tablet as an aid to inputting information; it corresponds to a menu on which items are selected while the pointing device is pressed. Templates are customized either to a specific application (CAD being the most prevalent one) or to an operating system.

Resolution A measurement of how many lines can be individually distinguished within a given distance. The more lines of resolution per inch, the better.

Accuracy describes how closely a digitized point comes to the correct representation of the cursor position. The smaller this distance, the better. Human and environmental factors like humidity, electricity, and stylus tilting can cause the accuracy to deteriorate.

	Pentel DST-4AN Pentel of America $420 including pen	Genius Digitizing Tablet GT-1212A KYE International Corp. $429 including cursor	SketchMaster GTCO Corp. $449 including pen and cursor	Drawingboard 2300 Model 23120 CalComp $595 including pen and 4-button cursor, or 16-button cursor
Size of tablet in inches	17.3 x 11.0 x 1.2	16.3 x 16.6 x 1.9	15.5 x 15.5 x 2.6	14.4 x 15.9 x 1.7
Size of work space in inches	11.7 x 8.3	12.0 x 12.0	12.5 x 12.5	12.2 x 12.2
Technology used	Electromagnetic	Electromagnetic	Electromagnetic	Electromagnetic
POINTING DEVICES				
Pen with button	□	■	■	Optional ($115)
Pen with ink	□	□	■	□
4-button cursor	Optional ($90)	■	■	■
16-button cursor	□	□	□	■
Other cursors available	□	□	□	□
Mouse driver	□	□	■	□
Device is programmable	□	□	■	□
Other pointing devices available	□	□	□	Pressure-sensitive stylus ($595), dual-transducer y-box ($245)
Pen proximity (inches)	1/16	3/4	1/4	7/8
Cursor proximity (inches)	1/16	3/4	1/2	1
Screen displays work in real time	■	■	■	■
Connection to PC	Serial port	Serial port	Serial port	Serial port
Length of pen cord (inches)	36	45	39	42
Length of cursor cord (inches)	36	47	46	42
TEMPLATES				
AutoCAD	□ (Version 2.6 only)	□	■	■
Microsoft Windows	□	□	■*	■
Other	None	CassCAD	Cadkey*, VersaCAD*	Cadkey, VersaCAD
Allows user-customizable macros	□	□	■	□
Software supplied	None	AutoCAD Template Menu, Dr. Halo III, Menu Maker	AutoCAD and Windows drivers	Driver supplied with AutoCAD or Windows template
MANUFACTURER'S PERFORMANCE CLAIMS				
Resolution (lines per inch)	200	1,000	1,000	1,016
Accuracy (inches)	0.1	0.01	0.01	0.025

■=Editor's Choice   ■=Yes   □=No

*This template can be obtained with an included coupon redeemable through Promontory Systems.

GraphicMaster	Numonics 2206	HP SketchPro	SPC-1212 Opaque Digitizer	SummaSketch II	Penpad 300	Tiger Tablet	Wacom SD-420L
Numonics Corp. $595 including pen and 4-button cursor, or 16-button cursor	Numonics Corp $595 including pen and 4-button cursor, or 16-button cursor	Hewlett-Packard Corp. $599 including pen and cursor	Scriptel Corp. $599 including pen or cursor	Summagraphics Corp. $599 including pen and cursor, or $699 with 16-button cursor	Pencept $695 including pen or cursor	Hitachi America HDG-1111C $727	Wacom Corp. $795
15.0 x 15.0 x 1.0	23.0 x 23.0 x 1.0	11.0 x 11.0	15.5 x 16.5 x 2.9	16.2 x 16.5 x 1.7	15.7 x 16.6 x 0.6	17.2 x 18.0 x 2.8	18.5 x 16.5 x 3.0
12.5 x 12.5	20.5 x 20.5	11.0 x 11.0	12.2 x 12.2	12.0 x 12.0	11.0 x 11.0	11.0 x 11.0	12.0 x 12.0
Electromagnetic	Electromagnetic	Electromagnetic	Resistive decoding	Electromagnetic	Electromagnetic	Electromagnetic	Electromagnetic
Optional ($75)	Optional ($75)	□	□	□	■	■	Optional ($60)
Optional ($205)	Optional ($205)	□	□	■	□	Optional ($251)	Optional ($150)
□	□	□	□	□	□	12-button ($271)	□
■	■	□	■	□	□	□	■
■	■	□	□	□	□	□	□
□	□	□	□	□	□	□	Pressure-sensitive stylus ($125)
1 1/4	1/4	1/8	3/8	1/2	7/8	1/8	1/4
2	3/8	3/8	3/8	3/4	1 1/4	1/4	1/4
■	□	□	□	□	□	□	■
Serial port	Serial port	Serial port	Serial port	Serial port	Serial port	Serial port	Serial port
40	35	29	48	39	48	33	Cordless
40	37	31	44	39	48		Cordless
□	□	□	□	■	□	□	□
Setup	No	No	No	Cadkey*, VersaCAD*	No	VersaCAD	None
□	□	□	□	□	□	□	□
AutoCAD and Windows drivers, diagnostics, PC and Macintosh drivers	AutoCAD and Windows drivers, diagnostics, PC and Macintosh drivers	None	None	AutoCAD and Windows drivers, test and reset utilities	AutoCAD and Windows drivers, diagnostics and configuration, documentation	None	Test and diagnostics, AutoCAD driver
1,000	1,000	1,219	1,000	1,016	1,000	1,000	1,270
0.01	0.02	0.02	0.01	0.015	Cursor, 0.001; stylus, 0.005	0.02	0.01

CONTINUES

"Uh, my system crashed and my file disappeared."

"I'm sorry about those files but I'm sure there's hard copy around here somewhere."

"Someone must have been playing with my computer while I was out to lunch."

"My secretary spilled a cup of coffee on my desk and it ran over my disk."

"I don't know what happened to the files, they just disappeared."

"Nobody told me that I was supposed to backup."

"My dog ate my data."

"I put the files on the floppy and then someone must have taken my disk."

"Well, it's a long story and I wouldn't want to bore you..."

"Have you ever had one of those days?"

"I can't believe that it's my fault, it's your system."

"I think I'm in trouble here."

You are surrounded by a bunch of losers.

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And every day the situation gets worse. More and more of your company's critical data is taken off the network and manipulated on desktop computers. By users who mean well, but back up irregularly, improperly or not at all.

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DIGITIZING TABLETS: SUMMARY OF FEATURES

(Products listed in ascending price order)

	HIPAD Plus 9018 Houston Instrument $895 including pen and cursor	CalComp 2500 Series Model 25120 CalComp $915	IS/ONE Kurta $995 including choice of pen or cursor	RDT-1212 Transparent Glass Digitizer Scriptel Corp. $995 including pen or cursor	Wacom SD-421L Wacom $895	SummaSketch II Professional Summagraphics $999 including pen and 4-button cursor, $1,099 with 16-button cursor	Penpad 320 Pencept $1,095 including pen or cursor
Size of tablet in inches	21.2 x 16.5 x 1.7	18.5 x 15.7 x 2.5	20.0 x 16.0 x 2.8	15.7 x 15.3 x 2.1	16.5 x 16.5 x 3.0	23.0 x 17.5 x 1.7	15.7 x 16.6 x 0.6
Size of work space in inches	12.0 x 18.0	12.0 x 12.0	17.0 x 12.0	12.2 x 12.7	12.0 x 12.0	16.0 x 12.0	11.0 x 11.0
Technology used	Electromagnetic	Electromagnetic	Electromagnetic	Resistive decoding	Electromagnetic	Electromagnetic	Electromagnetic
POINTING DEVICE							
Pen with button	■	❑	■	❑	Optional ($60)	■	■
Pen with ink	■	❑	■	❑	❑	❑	❑
4-button cursor	■	Optional ($206)	■	■	Optional ($150)	■	■
16-button cursor	❑	Optional ($275)	■	❑	❑	❑	❑
Other cursors available	❑	❑	❑ 12-button ($195)	❑	❑	❑	❑
Mouse driver	■	❑	■	❑	■	■	❑
Device is programmable	■	■	■	■	❑	■	■
Other pointing devices available	❑	❑	4-button cordless cursor ($100), 3-button cordless stylus ($100), 2-button stylus ($100)	❑	Pressure-sensitive stylus ($125)	❑	❑
Pen proximity (inches)	3/4	7/8	1/2	3/6	1/4	3/4	7/8
Cursor proximity (inches)	1/2	3/4	1/2	3/6	1/4	1/4	7/8
Screen displays work in real time	■	■	■	■	■	■	■
Connection to PC	Serial port	Serial port	Serial port	Serial port	Serial port	Serial port	Proprietary full slot interface card
Length of pen cord (inches)	35	51	40	48	Cordless	39	48
Length of cursor cord (inches)	35	51	43	44	Cordless	39	48
TEMPLATES							
AutoCAD	■*	❑	Optional $99	❑	■	■*	❑
Microsoft Windows	❑	❑	■	❑	❑	❑	❑
Other	Cadkey*, VersaCAD* setup menu	❑	PageMaker, VersaCAD	❑	❑	Cadkey*, VersaCAD*	Cadkey, CADvance, Pendraw, Penform, VersaCAD
Allows user-customizable macros	■	■	■	■	❑	■	■
Software supplied	AutoCAD driver	None	IS/Pensmith	None	AutoCAD driver, test and diagnostics	AutoCAD and Windows drivers, test and reset utilities	AutoCAD and Windows drivers, diagnostics and setup, Microsoft Mouse Driver, one Penpad application
MANUFACTURER'S PERFORMANCE CLAIMS							
Resolution (lines per inch)	2,540	1,278	1,000	1,000	1,270	1,016	1,000
Accuracy (inches)	0.01	0.015	0.035	0.01	0.01	0.015	Cursor, 0.001; stylus, 0.005

❑—Editor's Choice   ■—Yes   ❑—No

*This template can be obtained with an included coupon redeemable through Promontory Systems.

	Datatab ACT1212 ALTEK $1,310	Grafbar GP-7 Mark II Science Accessories Corp. $1,315 including pen or 4-button cursor	Wacom SD-322L Wacom $1,345	ZedPEN Numonics $1,395 including pen	Penpad 310 Pencept $1,395 including pen or cursor
	25.2 x 19.2 x 1.8	15.9 x 19.0 x 6.5	20.7 x 20.7 x 3.5	21.5 x 16.2 x 2.5	15.7 x 16.7 x 0.6
	19.3 x 13.4	25.5 x 23.5	16.0 x 16.0	17.5 x 12.7	11.0 x 11.0
	Electromagnetic	Sonic pulse	Electromagnetic	Electromagnetic	Electromagnetic
	❏	❏ 4	Optional ($80)	❏	■
	■	■	■	■	■
	Optional ($290)	❏	Optional ($150)	■	■
	Optional ($360)	❏	❏	❏	■
	2-button ($145)	1-button ($175)	■	❏	❏
	❏	❏	■	■	❏
	❏	❏	■	■	❏
			Pressure-sensitive stylus ($125)		
	3/8	27	1/4	1/2	7/8
	1/2	27	1/4	N/A	7/8
	❏	■	■	❏	■
	Serial port	Serial port	Serial port	Serial port	Serial port
	38	60	Cordless	44	48
	42	60	Cordless	N/A	48
	❏	❏	❏	❏	❏
	❏	None	❏	❏	Cackey, CADvance, DOS, Pendraw, Penform, VersaCAD
	❏	❏	❏	■ (through optional software)	❏
	None	On request: AutoCAD driver, Microsoft Windows 1.03, startup package	AutoCAD driver, test and diagnostics	None	ADI driver, diagnostics and setup, Windows driver, one Penpad application
	1,000	254	1,270	1,000	1,000
	0.001	0.01	0.01	0.025	Cursor, 0.001; stylus, 0.005

ENDS

and allow control of cursor output, aspect ratio, size, tracking velocity when emulating a mouse, and more, even with applications that don't have these features. The remaining ten soft keys are there for software developers to use, but sadly, there is no way for the casual user to program them.

HP's buttonless pen is one of the most comfortable to use, and a welcome by-product of its frictionbal shape is its resistance to rolling off the tablet every time it is set down. The cord, at just 29 inches, is rather short, however.

The cursor, although attractive, is sometimes difficult to use. Unlike the 1.5-inch antenna coils used by some of the other manufacturers, HP has chosen a diminutive 0.1-inch aperture, further obscured by a red dot in its center. Tracing really intricate drawings could make you squint more than Mr. Magoo.

HP gets high marks for the excellent documentation supplied with the Sketch-Pro. Thorough and well illustrated, it makes light work of selecting settings for the formidable bank of 32 DIP switches on the back of the tablet. Indeed, the list of switch settings for ten popular CAD programs is all that many users will ever need

to know, but for those with unusual requirements, the manual will prove welcome.

In addition to its native mode, the SketchPro provides emulations of the Summagraphics Bit Pad II and Hitachi's HDG-111B tablet (the latter with Auto-CAD). It can also emulate a Microsoft mouse when used with the driver supplied on a diskette.

When used with AutoCAD the SketchPro's only downside: less than perfect performance. Its continuous cursor rate was slow, making for intermittent updating of the on-screen image position. Button clicks were also occasionally missed when either pointing device was

moving quickly across the board.

The pen functioned reliably only when within 0.12 inch of the tablet's surface. Even though this exceeds HP's claim of operation within 0.1 inch, it precludes the tracing of relatively thick objects, such as a page bound within a book or magazine.

Despite these criticisms, the Hewlett-Packard SketchPro remains a leading contender for PC-based CAD applications when quality and completeness outweigh the quest for a rock-bottom price.

HITACHI AMERICA LTD.
Tiger Tablet HDG-1111C
by Frank Bican

With products ranging from nuclear reactors to medical instruments to television sets to semiconductors, Hitachi has burgeoned into a multinational conglomerate. But behemoth sales don't necessarily signal the most innovative products in a particular product line. That's the impression you get from the Tiger Tablet HDG-1111C.

A simple white wedge of plastic, the work surface is free of any seams. This may be as much for safety as anything else, because while the majority of the tablets we looked at were powered by the serial port or low-voltage power transformer, this one runs directly off a 110-volt power cord. A little spilled coffee could have disastrous consequences if it found its way inside.

Judging by its prodigious physical dimensions (17.2 by 16 inches), one would expect a larger workspace than the Tiger's 11 by 11 inches. It is probably for this reason that Hitachi put a proximity indicator LED along the top to indicate when the pointing device is within the active areas. AutoCAD users may long for more than the meager 7.9- by 8.9-inch drawing space they will find.

Placing your favorite tools on top of the tablet may not be the best idea. Because it is painted with a particularly abrasive bright white paint, it tends to pick up scuff marks quite easily. Indeed, after undergoing tests in PC Labs, our unit picked up a couple of marks from a ruler being used for measurements.

On the rear of the enclosure are 24 DIP switches for configuring the tablet for applications. We were lucky—the switches were set properly for AutoCAD right out of the box. If the settings aren't right for your software, you'll have to consult the relatively skimpy manual for help. Its tables list each switch's function, but it doesn't offer any advice on which selections should be made for any of the major CAD packages.

Testing in PC Labs showed the HDG-1111C to be a rather lackluster performer, particularly when we used the pen. When it was raised as little as .12 inch from the work surface, the on-screen image jumped around wildly.

The optional 4- and 12-button cursors ($251 and $271, respectively) supplied with the test unit performed somewhat better, with no problems encountered until they were raised more than .25 inch off of the board. Both have .5-inch diameter nonmagnifying reticles that provide clear views of your work. Curiously, though, the 4-button cursor is fitted with a felt friction-reducing pad on the bottom, while the 12-button cursor has none.

Most interesting of all the Tiger Tablet's pointing devices is the optional 3-button pen ($159). It has an angled tip that remains perpendicular to the tablet when held at a conventional writing angle, three backward-sloping buttons along its top

Hitachi America's Tiger Tablet HDG-1111C is one of the biggest and newest names in the tablet market. It offers lackluster performance for the higher-than-average price of $727, which does not include any pointing devices, templates, or cables.

edge, and a pair of wings at the back, presumably to keep it from rolling off the tablet when laid down. This is the pen that Buck Rogers would wear.

The Tiger Tablet's most serious flaw is its price—$727. That's a whole lot for a tablet with no overlay, templates, cable, or standard pointing device. A bare-bones configuration will set you back a whopping $915. There are more-attractive digitizing alternatives available for considerably less money.

HOUSTON INSTRUMENT
HIPAD Plus 9018
by Frank Bican

The Houston Instrument moniker has become practically synonymous with plotters and tablets at engineering firms throughout the world. Its HIPAD Plus line of tablets runs the gamut from a $5,400 44- by 60-inch monster right down to the $895 12- by 18-inch unit (and its $550 12- by 12-inch sibling) that we evaluated.

Those obsessed with numbers and specifications will delight in the HIPAD Plus 9018. Its 2,540-line-per-inch resolution is more than double that of many of its competitors. Its maximum communication rate is 38,400 bits per second, four times quicker than most. And finally, in addition to its native mode, it possesses full or partial emulation modes for no fewer than 12 other graphics tablets and a Mouse Systems mouse.

Constructed of an attractive dark-gray plastic, the tablet is a slender 1.7 inches thick at the rear, tapering to just .5 inch at the front, giving the work surface a slight slant. Should additional tilt be desired, two plastic legs can be folded out of the bottom.

The 9018's 12- by 18-inch workspace

is covered by a very heavy clear acetate overlay. While it would most often be used to hold a working drawing in place, it is also used to hold the parameter menu template.

Unlike many other tablets, this one doesn't have a single DIP switch. All of the parameter settings are made with a pointing device and the parameter template. These include such settings as baud rate, emulation mode, report rate, and resolution.

The procedure for changing parameters is quite simple. While pressing a switch on the back of the tablet (it's not necessary to quit whatever program is running), you just hold either pointing device over the desired selection and press any of its buttons. The tablet will beep to let you know that the selection has been made. When everything is properly configured, these start-up settings can be saved in nonvolatile RAM. Be careful not to misplace the template, because changing settings without it will be difficult.

Houston Instrument claims that the HI-PAD Plus 9018 contains special circuitry that eliminates parallax errors that can be caused by tilting the pen. Testing at PC Labs tended to bear out that assertion, at least while the pen was held at an angle of 45 to 90 degrees to the tablet. Below 45 degrees, the tablet simply stopped sending any coordinates to the PC. It's hard to

The HIPAD Plus 9018 is Houston Instrument's best digitizing tablet. At $895, it may be expensive, but in this case you get what you pay for. Outstanding speed, 2,540-line-per-inch resolution, and your choice of application templates make the HIPAD a good buy.

imagine why anyone would want to hold it at such a shallow angle, though.

The standard four-button cursor proved to be every bit as capable a performer as the pen. Far from the minuscule antenna coils found on some cursors, this one measures a generous 1.1 inches in diameter. Within it is a nonmagnifying cross-hair reticle that proved quite easy on the eyes when tracing out a drawing.

In addition to its plethora of tablet emulations, the HIPAD Plus 9018 includes a disk with an Autodesk ADI device driver. In addition to allowing the tablet to function with *AutoCAD*, the tablet is supposed to function with *AutoSketch* and *AutoShade* as well.

Even though you probably won't have to consult the manual very often, you'll appreciate what a clear and thorough job Houston Instrument has done with it. It certainly rates as one of the best of the lot.

Although the suggested list price of $895 is fairly high among this group, it seems completely in line, considering the 9018's spacious 12- by 18-inch workspace and excellent performance. For those on a tighter budget, the HIPAD Plus 9012 offers identical performance in a smaller, 12- by 12-inch tablet for a more affordable $550.

KURTA CORP.
IS/ONE
by Frank Bican

Cordless technology is being applied to a growing number of applications, keeping battery makers smiling all the way to the bank. These devices range from conveniences (such as a cordless phone or a battery-powered laptop) to devices that could not exist without cordless control. Just try to picture a corded garage door opener.

Cursors and pens with cords are quite usable, and they have the advantage of being difficult to lose, but once you've tried Kurta's cordless counterparts with the $995 IS/ONE (Input System/ONE) tablet, you'll never want to go back.

Tablets were originally designed to make drafting work easier—cordlessness brings ease-of-use one step further. Switching between a cursor and pen with most other tablets means unplugging one, plugging in the other (maybe untangling the cords), and perhaps changing a few DIP switch settings.

Not so with the Kurta's cordless pointers. Just pick up the pointer you want and you're ready to go. Switching among pointers during an *AutoCAD* drawing proved quite useful. I could use the cursor for laying out precise lines and then change to the pen for a tidy freehand work.

Both the three-switch pen and the four-button cursor are powered by five LR44-size alkaline batteries. To keep them from wasting their precious energy when left unattended, Kurta has designed hand-capacitance switches into each so that they operate only when being held.

Expanding on the IS/ONE's capabilities, Kurta offers over 20 templates, ranging from general-purpose CAD applica-

The Kurta IS/ONE tablet, $995, is a former *PC Magazine* Award for Technical Excellence winner that brings the ease-of-use and convenience of cordless technology to digitizing tablets. Twenty programmable soft keys reside along the top, allowing you to expand the tablet's power and functionality.

tions, to specialized subtemplates (fluid power, architecture, and the like), to *PageMaker*. Although the $99 price for each seems a bit high, the templates could prove to be worth far more if you really need them.

Besides the templates, the IS/ONE also incorporates a horizontal row of 20 programmable soft keys along the top edge of

the work surface. Four of these select various working combinations of the pen's switches, five select among alternative operating modes, and the remainder can be programmed. When used with a program on the utility disk, the resultant macros can be stored in a file for later recall.

Also on the utility disk is a device driver that Kurta refers to as PENSMITH. It serves as both an *AutoCAD* ADI driver as well as one for a Microsoft mouse. Toggling between tablet and mouse modes requires a click on one of the soft keys.

All three of Kurta's cursor configurations are quite colorful. The buttons are arranged in circular fashion, and each is a different color. Handsome though they may be, I doubt that the 12- or 16-button models are particularly easy to use without some practice. In any case, their nonmagnifying, half-inch cross-hair reticles are adequate for most applications.

Tests at PC Labs showed all of the IS/ONE's pointing devices to be similar performers; each could continue tracing over objects as thick as 0.5 inch. Even though the cordless pointers seem like prime candidates for interference, none was observed.

The cabinet of the IS/ONE is made of a uniform gray plastic and measures 20 by 16 inches. A recessed 17- by 12-inch workspace holds a sturdy acetate overlay.

Although the review unit's overlay was smooth, a matte-finish version is available as an $18 option.

On the back of the enclosure is a bank of 24 DIP switches that select the default configuration as well as connectors for the power cord, cord-type pointing device, and serial cable. The last has a DIN-type connector at the tablet end and a DB-9 connector for the serial port.

Further enhancing the appeal of this tablet, Kurta offers interface kits for Macintosh Plus, SE, and IIx systems, and for the Amiga.

Unless you can think of some reason why you must have a corded pointer, stick with one of Kurta's cordless models (they cost no more, and in some cases less) and relish the freedom the IS/ONE provides.

KYE INTERNATIONAL CORP.
Genius Digitizing Tablet GT-1212A
by Frank Bican

KYE International Corp. offers a number of alternate input devices and attendant software for many graphics applications, including scanners, mice, and entry-level CAD and desktop publishing software. The most interesting and ambitious of the lot, though, has to be the Genius Digitizing Tablet GT-1212A.

Bundled as a relatively complete package including tablet, four-button cursor, *AutoCAD* template, and more software than you might expect, the Genius Tablet is a surprising bargain.

Its $429 suggested list price makes the GT-1212A one of the least-expensive tablets available. That would be a reasonable enough price, but a quick check through some recent mail-order ads revealed prices as low as $309.

For that sum, KYE throws in quite a bit more software than the usual *AutoCAD* driver. You get a copy of Media Cybernetics' *Dr. Halo III*, a general purpose icon-based drawing program much along the lines of *PC/Paintbrush Plus*. It's not the type of program one would use as a substitute for an honest-to-gosh CAD package, but then again, it's a whole lot easier to use for making freehand drawings.

But that's not the last of the bonus software. KYE also bundles *Genius Menu*

Maker, a program that can be used to generate pop-up function menus not only for CAD applications, but for programs such as *Lotus 1-2-3* as well. *Menu Maker* would seem to be better suited to a mouse than a tablet, but that's all right because the Genius tablet is capable of emulating both Microsoft and Mouse Systems mice.

One of the Genius tablet's more unusual features is its power source; the tablet gets its juice from the keyboard socket. A 12-inch cable runs between the keyboard plug and the tablet and diverts power through another short cable to a jack on the side of the serial port connector. This works well enough on an IBM or similarly constructed compatible where both the keyboard and serial port jacks are on the back of the cabinet. But on systems such as the Compaq Deskpro 386/25, where the serial port is on the back and the keyboard connector is on the front, it's an invitation to test the tensile strength limit of the adapter cable. For those not wishing to entwine their system with this cardiac bypass arrangement, an optional external power supply is available.

The two-button pen that is supplied with the GT-1212A is well-styled, but the four-button cursor leaves plenty to be desired. Its toylike neon-bright buttons beg to

KYE International Corp.'s Genius Digitizing Tablet GT-1212A doesn't represent any technological breakthroughs, but for $429, it's one of the least expensive and most complete packages available. It comes with a stack of software, including *Genius Menu Maker*, a program that lets users generate pop-up menus for many applications.

be yanked out by a two-year-old. Beyond
that, the nonmagnifying reticle, though of
adequate diameter, has cross hairs that are
embossed into it rather than painted on.
Unless oriented just so to the ambient light
in the room, they are really quite difficult
to see.

In testing, the Genius GT-1212A
proved to be a capable, if not distin-
guished, performer. Both pointing devices
were usable all the way out to 0.75 inch
from the tablet's surface, and no matter
how quickly an image was drawn, it re-
mained faithful to the intent of its creator.

When price and versatility are your
main considerations in selecting a graphics
tablet, give the KYE Genius GT-1212A
careful consideration. It may not advance
the state of the art, but it offers a lot for
your money.

NUMONICS CORP.
Numonics 2206
GraphicMaster
ZedPEN
by Winn L. Rosch

Numonics has moved up from an undistin-
guished position in the tablet market to a
solid number three in a newfangled
way—mergers and acquisitions. In June
1987 it acquired Pencept; in October 1987
it added mouse-maker Torrington to its as-
sets; and in April of this year it joined with
Terminal Display Systems, England's
only tablet-maker.

These three products give glimpses of
that evolution. ZedPEN represents a novel
technology added through the merger with
TDS. The Numonics 2206 is the recent
outgrowth of a proven line of Numonics

tablets. The GraphicMaster is a revolu-
tionary new offering crafted by Pencept
that pits Numonics squarely against the lat-
est and best the tablet market has to offer.

Introduced in October 1988, the $595
Numonics 2206 combines the best features
of the company's 2205 (introduced in
April 1987) and 2207 (introduced in April
1988), specifically, the quality and fea-
tures of the former and the trimmer styling
and downloadable commands of the latter.

While the combination is a good one,
it's definitely dated. The result is still a
big, heavy, pad measuring 23 by 23 inches
and 1 inch thick. Covered in white-beige
plastic, it's built on a solid black metal
foundation. The top surface is unmarked
except for the Numonics logo and model
number. The 20.5- by 20.5-inch active
area is not indicated in any way.

The tablet draws its electricity from a
large black brick transformer that burrows
into a wall outlet, supplying 500 milliamps
of 5 volts DC and 130 milliamps of 12
VDC through its 78-inch cord. Numonics
also supplies a 112-inch serial cable with
the 2206, terminating in either a 9-pin D-
shell (for ATs) or a 25-pin D-shell; you
choose when you order.

The 2206 tablet provides two jacks on
its rear panel that allow you to plug in both
a cursor and pen at the same time. It gener-
ally recognizes whichever one is closer to
the tablet.

The four-button cursor looks like a
Transformer stolen from a child's toy box;
it has a dark gray angular case with inset
finger grips at either side. The 2.25- by
3.12- by 0.75-inch case is extended by a
1.5-inch reticle with a small central circle
not pierced by the plus-shaped hairlines.
It's easy to grasp but forces your fingers
into a pincerlike grip that may not be com-
fortable for long periods. The cursor is
available in one- and four-button models
for $105, a 16-button version for $205,
and a number of other variants.

The pen, 1.5 inches around and 6 inch-
es long, is a fat imitation of a fountain pen.
Although its plastic case feels a little slip-
pery, it is easy enough to use. The inkless
cartridge supplied by Numonics was
molded from nylon; its almost dangerously
sharp point quickly wears down to a
smooth tip after a few minutes of use.

The $65 pen uses a tip-switch as its only
control. For an additional barrel-mounted
button, you'll have to spend $75 for the
two-switch pen. All pointing devices for
the 2206 are equipped with 36-inch cables.

Neither cursor nor pen demonstrated
much proximity range. The pen was reli-
ably detected at .25 inch; the cursor, at .37
inch. One feature we were delighted to
find defeatable was the beep emitted by the
tablet every time a point was indicated.
Worse than the headache it caused, the
beep slowed down response. Although the
on-screen cursor moved rapidly, when
points were specified in quick succession,

The three tablets representing Numonics' line include (left to right) the $1,395 ZedPEN, the
$595 Numonics 2206, and the $595 GraphicMaster. The ZedPEN and the 2206 were once
revolutionary products whose practicality and ergonomics have waned in comparison with the
evolutionary, sleek, and upwardly mobile GraphicMaster.

often several would be lost because of beeping overhead. Turn off the beep, and the 2206 keeps up with the quickest *AutoCAD* drawing.

The setup of the 2206 is probably its most retrograde feature. To get the 2206 working, you must first adjust a bank of DIP switches on the rear panel to set serial speed and emulation mode, a process that is not helped much by a little pamphlet Numonics calls a user guide. We found (through experimentation, not through the pamphlet) that *AutoCAD* worked best with the 2206 in Summagraphics MM emulation, but the tablet yielded a modest 9.5- by 10-inch pad to cover the active drawing screen.

On the positive side, the 2206 is supplied with two disks of software that include ADI, mouse, and *Microsoft Windows* drivers in addition to diagnostics and field support.

THE GRAPHICMASTER

While the 2206 is evolutionary, the GraphicMaster is revolutionary, at least for Numonics. Because it's essentially a minimalist pad, it's a most desirable tablet. Heft the 15- by 15- by 1-inch tablet, and you'll think that there's almost nothing in your hands. The pad is only a thin sheet of plastic with a raised honeycomb of reinforcing ridges on the bottom. At about 2.25 pounds, it would be perfect for use on your lap if the ridges didn't do a meatcutter's job on your legs.

Underneath the tablet is a small area about the size of an index card that holds all of the electronics of the unit. On the right side of the electronics box are a jack to plug in the cursor and an LED to indicate mode changes.

The light weight of the pad is complemented by the relative freedom of having only one tether besides the cursor cable. Both power and signal travel through the same 81-inch cable. A 9-pin D-shell connector plugs into the back of the tablet, and a 25-pin D-shell is included for plugging into your own serial port. The Graphic-Master draws all the power it needs through the serial connection.

The menu system built into the electronics is activated by unplugging the cursor (or pen), holding down one of its buttons, then plugging it back in while keeping your finger on the button for two flashes of the LED indicator on the side. The placement of this LED is a design error—it should be on top of the tablet where it can be seen.

After the flashes, the tablet itself becomes a selector—move the cursor to the emulation or operating mode you desire from those printed on the cheap paper menu template supplied with the tablet, then click. Emulations include Numonics, BPI, Summagraphics MM and Delta, Microsoft Mouse, and ASCII characters. As vital as this setup template is, it should be laminated or printed on something more substantial than the paper that was supplied with the unit we investigated.

The GraphicMaster tablet works quite well, and it proved more than up to the speed required for *AutoCAD* with its 160-point-per-second maximum drawing speed. The range of its sensors was large, losing proximity only after the cursor was withdrawn 2 inches away from the tablet. At that point it became unstable and sent a jittery stream of data, with the indicated cursor position varying wildly until contact was lost. Resolution reaches the 1,000 lines per inch common among tablets. Accuracy is rated at 0.01 inch.

The four-button cursor accompanying the GraphicMaster has a 40-inch cord. Although shaped like a mouse, it's somewhat

smaller (2.25 by 3.25 by 0.5 inches with a 1.5-inch paddle) and the buttons require curling your hand into an uncomfortable grip. The four blue buttons of the standard cursor are arranged in an inverted T, and the reticle is a pair of cross hairs with a small central target circle.

Slightly streamlined, the GraphicMaster pen is among the more comfortable pens to hold. The pen features a tip-switch and a sharp nylon uninked tip much like that of the 2206.

GraphicMaster pointing devices arrived with 40-inch cables ending in three-conductor miniature phone plugs. A 16-button cursor is available as a substitute for the combination of 4-button cursor and pen that's supplied as standard equipment. The tablet includes a Microsoft Mouse emula-

> Slightly streamlined, the GraphicMaster pen is among the more comfortable to hold.

tor, a *Windows* driver, and an *AutoCAD* ADI driver in addition to its diagnostics and maintenance routines.

THE ZEDPEN

The ZedPEN system looks radically different from the rest of the Numonics line and most other tablets that find their way to these shores, probably because it comes from across the Atlantic, where Terminal Display Systems is the leading tablet vendor. The ZedPEN was the first product there to add a third dimension to tablet digitization. In England, what we call *zee*—as in *z*-coordinate—is pronounced *zed*, hence the name ZedPEN.

The tablet reflects another transatlantic difference. In America, the 12- by 12-inch tablet is tops; in Britain, it's the 12- by 17-inch size (standards A4 and A3, respectively). The tablet received for review, an A3, is thus hefty and expensive by U.S. standards: 14.5 pounds and $1,955. Zed-PEN is also available in the smaller A4 format for $1,600.

The ZedPEN tablet is a white lucite wedge measuring 21.5 by 16.25 inches and rising from just under one inch at the front edge to a little over 2.5 inches at the

rear. The drawing surface, with a 17.5- by 12.73-inch active area, is set off by a border about an inch wide around the tablet, a little wider on the right edge where there is a shallow trench for resting your pen.

On the back panel you find the connector to plug in the pen, a 12-VDC input to power the tablet, a red indicator LED, a small (.1 inch) reset button, two serial ports that use 25-pin D-shell connectors, and a 9-pin D-shell connector for the Zed-PEN itself. All of the connectors are recessed about 2 inches under top of the tablet so that the connectors stay out of your way. The external transformer connects through a generous 112-inch cord, and the serial cable provided is even longer at 127 inches.

The ZedPEN pen is finished in brushed stainless steel and measures about 1.5 inches in circumference and 6 inches long. Although the steel makes it sturdy, the pen feels somewhat slippery. Because of the design of its sensory mechanism, ink cartridges cannot be loaded.

The entire ZedPEN system is self-programmed using the pen, tablet, and standard setup template. Press the reset button on the back of the tablet and it enters its setup mode. All you need to do is select mode or emulation is press the pen against the appropriate menu choice. Nonvolatile memory within the tablet remembers your choice. However, setting up the tablet is an act of faith because it yields no visual indication of its settings or even that a setting has been accepted and updated.

The proximity range of the system proved modest, only about 0.25 inch. The system is quick enough to draw points as fast as you can press them into *AutoCAD*.

The distinctive feature of the ZedPEN is its pressure sensitivity. The force applied to the pen tip is digitized and transmitted to the pad's computer host for use as applications see fit. The ZedPEN distinguishes 128 discrete pressure levels. At one time, the ZedPEN system was the only pressure-sensitive tablet available. Now it is showing its age (three years) as 256-level pressure pens and cordless pressure pens increasingly become available.

The ZedPEN is still a workable choice for applications that call for an extra dimension. However, it may no longer be the best choice. The same is true of Numonics 2206. The GraphicMaster, however, can hold its own against the best of them.

Penpad 300
Penpad 310
Penpad 320

by Winn L. Rosch

Putting pen to tablet makes us wonder why we must still rattle our fingers on pesky and frustrating keyboards to get the words we want on PC screens. If we can draw on tablets, why can't we write what we want to say? Why can't computers understand what we write as they do what we type?

The same thoughts evidently occurred to the engineers at Pencept—and they did something about it. The top of the Penpad line amounts to what must be the smartest tablets around. Not only do these tablets let you draw lines but they can recognize your handwriting—or rather, your printing—as well, albeit within some rather severe limitations.

This sampling of three tablets from Pencept (now part of the Numonics empire) shows the most and least of the current product line. At the bottom is the Penpad 300, a tablet that simply adds a few new nuances to conventional digitizing designs. At the top is the Penpad 320, essen-

tially a 300 with a college education—or at least grammar school training. Courtesy of hardware and software add-ons to the basic 300, it gives a snapshot of the future potentials of digitizing technology. The Penpad 310 crowds the 320, offering its capabilities to computers and workstations lacking the standard PC expansion bus.

Though at the bottom of the Pencept line, the $695 Penpad 300 is out ahead of other tablets as far as claimed accuracy is concerned. Switching to a pen trims accuracy (but not resolution) down to 0.005 inch, twice as sharp as the best of the rest. Because the other Penpad tablets share the same 300 mechanism, their specifications are the same.

Although this accuracy level is commendable, it's probably unnecessary for most applications.

elicit elaborate functions. Or you can just write in data instead of typing it.

Externally, the Model 300 tablet upon which all three systems are based is refined but hardly distinguished. Like most recent tablet designs, it has the look and feel of a solid slab of plastic—and that's good. There's nothing to come loose or break. Measuring 15.75 by 16.75 inches, it yields a somewhat modest active digitizing area measuring 11 by 11 inches. Using its own driver under AutoCAD results in a drawing area of but 6.75 by 7.5 inches.

The one innovation incorporated into the Pencept design is a brown padded palm rest at the bottom of the drawing area that does double duty by stopping drawing

Pencept offers many strong choices in its line of tablets: from left to right, the $695 Penpad 300, the $1,395 Penpad 310, and the $1,095 Penpad 320. The innovative 310 and 320 each offer basic handwriting recognition, while the 300 has superior accuracy.

general drawing programs. But one critical application that likely benefits from the high accuracy is the recognition of handprinted text. Little wonder the more expensive Model 320 ($1,095) and the Model 310 ($1,395) are built on such a precise platform.

Using the highly accurate digitizations of hand-printed characters, the 310 and 320 apply powerful pattern-matching algorithms to recognize each individual character you draw on the tablet. Pencept's interface software then allows you to use the recognized characters just like typed data as input to your applications. The macro facility built into the Pencept programs allows one recognized character to

pens from rolling off the surface.

Mass is saved in the slim tablet by the use of an external power source. In the Model 300 system, electricity comes from a lamprey transformer that plugs into a standard wall outlet and pulls the 6 watts required to make the three different voltages that run the tablet. The power lead plugs into a 6-inch pigtail dangling from the 25-pin D-shell connector at the end of the 69-inch serial cable that plugs into your PC. The 310 and 320 get the needed power to the serial cable in a somewhat different manner using special interfaces.

The Penpad 320 uses a proprietary PC expansion board that requires one fulllength 8-bit slot for its connection with

your computer. Besides providing the interface, this expansion board also boosts the IQ of the tablet with an MC68000 microprocessor and a bevy of support circuits that power the print-recognition abilities. The Penpad 310 uses basically the same electronics but puts them in a heavy external box that connects to its computer host through a standard RS-232C link.

Installing the 320 host adapter steals an interrupt from its computer system host, factory configured as IRQ 2 but selectable between any of six values using on-board jumpers. The interface also requires the assignment of a port address, also selected with jumpers.

THE PEN

All Pencept products come with a pen as standard equipment. The Pencept pen is much like any other, about 6 inches long and a good match for a bulky fountain pen. Pens are supplied either with ink-filled cartridges or are inkless.

While the documentation claims Pencept pens are not field-serviceable (meaning you shouldn't dare try to change ink cartridges), the factory reports that most users take care of the simple cartridge replacement job themselves. Replacement cartridges, with or without ink, cost $2. The pen itself, one of which is standard equipment with any Pencept tablet, is pricey, listing at $250 when purchased separately.

However, instead of the pen, you can substitute a 4- or 16-button cursor to accompany a new Pencept tablet at no change in price. The cursors are gently curved though quite flat. The reticle, with horizontal and vertical cross hairs, is unusually large, and the resulting large sensing coil aids in achieving the tablet's high resolution. Purchased separately, the 16-button and 4-button cursors cost $250 apiece.

In use, the base Penpad 300 proved itself nimble enough to keep up with our fastest drawing. Using its pen, its proximity range measured a healthy 0.87 inch. With a cursor, it reached out to a generous 1.25 inches.

When used strictly with AutoCAD, the Penpads 310 and 320 did not fare as well, occasionally missing a point during rapid drawing. The problem appeared not to be one of communication but rather of processing overhead and the delays built into the general-purpose recognition system. This problem should not arise when you are using Pencept's CAD interface software. The Penpads 310 and 320 also demonstrated a more consistent proximity range, 1 inch, for both pen and cursor.

HAND-PRINTING RECOGNITION

Pencept justifies the added expense of the 310 and 320 by citing their hand-printing-recognition abilities. On the surface, this technology is more than remarkable; it hints at the power tablets can bring to your PC. But, alas, it's only a hint. The recognition abilities of the Penpads are quite limited—restricted for the most part to monospaced printed numbers and capital letters.

> Pencept brings a
> wondrous
> combination of
> revolutionary ideas and
> clever styling to
> digitization, including
> limited handwriting
> recognition.

Moreover, recognition is sensitive to the way you print individual characters. As with most inexpensive recognition systems, you must conform to the Penpad's wishes—it won't adjust to yours.

In the end, you must learn to print the way the Penpad wants you to. The better you get at scribbling the way it wants, the more accurately it will recognize what you print. After an hour of experimenting, some people in PC Labs were able to achieve a recognition rate of about 90 percent, which is exemplary performance according to Pencept. After you've used a Pencept tablet for a few weeks, the company reports, you can expect to achieve print-recognition accuracy of nearly 99 percent.

But recognizing characters seemed an agonizing chore, a process that dragged out for seconds with results that were, at best, a crapshoot. Don't judge the system by that, however. The free-form DOS recognition mode has built-in delays that help the tablet determine when you've finished scrawling each character. These intentional delays make the tablet slow.

Even within the DOS mode, however, the print-recognition system does some surprising things. For instance, when a character was misidentified on the command line, we traced over it again correctly on the Penpad. In an instant, the correct character appeared in its proper place on screen and in the DOS keyboard buffer.

Print-recognition comes into its own with the three Penpad application packages offered by Pencept. (You get your choice of one of the three or an application development kit with the Penpads 310 and 320. Separately these programs cost $195.) For example, the Pencad package offers a template for your favorite CAD program (providing your favorite is AutoCAD, CADvance, CADKey, MegaCAD DBP, VersaCAD, or the graphics presentation program Lotus Freelance) and a macro program. Combined, these features can considerably speed up the use of the underlying CAD application. For instance, to zoom in with AutoCAD, you don't have to tangle with commands or menus—just draw a Z on the Penpad.

Besides Pencad, Pencept also offers Pendraw, a screen-painting program for color presentation graphics that also includes screen grabber and slide show utilities (the current version has EGA but no VGA support); and Penform, a forms-creation package for data entry using the hand-printing recognition abilities of the Penpad to create either ASCII or .DIF files. Think of the latter as a product for people who fear the keyboard as if it were some dreaded social disease. In speed and accuracy, Penform is no threat to touch typists or even those of the two-fingered school. The Penpad Software Toolkit consists of thorough but brief technical documentation on how to program the Penpad and develop drivers for it.

Unfortunately, the documentation accompanying these applications is not up to the quality level of the Penpads themselves. For example, the Pencad manual is a daunting work that should make some technical writer's English instructor bury his or her head in shame.

Pencept brings a wondrous combination of revolutionary ideas, clever styling, and wide functionality to digitization, though the loose details of the Penpad applications need work. If you need accuracy, the Penpad 300 is your best choice. If you need to recognize hand-printing, the 310 and 320 are your only choices.

GbsSlipSheet-001

Folded edge of the page

Foldout slip-sheet

1. Open the foldout page

2. Insert this sheet with

    1. Front side touching the free page

    2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet

Inverted Back

||||||||||||||||||||||||||||||||||

Gpa5ipBack-0018

Back

1. Follow instructions on the other side

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PENTEL OF AMERICA LTD.
Pentel DST-4AN
by Frank Bican

Best known as a purveyor of pens and pencils, Pentel of America is also a leading supplier of replacement plotter pens. With the association between plotters and tablets as close as it is, the company's move into the tablet market seems only logical.

Pentel's initial offering, the DST-4AN, is something of a Lilliputian, even among this group of bantamweights. Measuring just 17.3 by 11 inches and weighing just over 3 pounds, it is one of the few tablets that seem equally at home on your lap or desktop. That may not mean much to CAD mavens, but it should be appreciated by those principally concerned with freehand drawing. In fact, serious AutoCAD users would most likely find the 6.3- by 7-inch workspace with that application inadequate.

The actual workspace on the DST-4AN is smaller still, measuring 11.7 inches in width by 8.3 inches in height. The remaining area, mainly along the right side of the enclosure, houses the circuitry and provides an indentation for holding the pen when it is not in use.

On its underside is a set of ten DIP switches for setting communication parameters and operating modes. Fortunate-

ly, switch settings tend to be set just once and then forgotten about—the instruction manual doesn't make the process particularly easy.

Pentel's trilingual (English, French, and German) documentation is quite terse in general, but the switch-setting table is as dizzying as they get.

Nowhere does the manual mention how to configure the DST-4AN to operate with AutoCAD or which AutoCAD device driver to use, so we called technical support at Pentel. With its courteous help, the switches were promptly set and tested using AutoCAD's Summagraphics Bit Pad driver.

Pentel is proud that the pen supplied with the DST-4AN is equipped with an uncommonly flexible cable. Indeed, the 36-inch cord rarely gets in the way, but it is no match for the cordless one available on Kurta's IS/ONE. Although an optional

($90) four-button cursor is available, none was supplied for our review.

The manufacturer claims that the DST-4AN is usable with objects up to 3 millimeters thick, but our evaluation unit wasn't nearly as generous. Indeed, it didn't always respond reliably even with the pen in contact with the board. This was most notable when the pen was being held exactly perpendicular to the work surface. It was far more dependable when the pen was held in a more natural writing position.

Metallic objects also have a tendency to give the DST-4AN a case of indigestion. A metal ruler resting on its surface caused the output to stop whenever the pen was brought within 0.5 inch of it.

The Pentel's maximum data output rate of 60 points per second would seem to be entirely adequate, but the speed at which

the tablet itself recognizes the position of the pen is quite slow. As a result, moving the pen around the work surface quickly results in hesitant on-screen image changes.

Although it can hardly be considered a top performer, the Pentel DST-4AN is reasonably inexpensive, and with a longer serial port cable it might just appeal to those who want to do a little freehand work from their laps rather than at their desks.

SCIENCE ACCESSORIES CORP.
Grafbar GP-7 Mark II
by Winn L. Rosch

Something's missing. Unpack Science Accessories Corp.'s Grafbar GP-7 Mark II tablet and you'll swear someone forgot to pack the tablet in the box. Once you have the system running, however, you'll wonder why other manufacturers waste so much space and energy in making tablets.

With the $1,315 Grafbar, any tabletop becomes a digitizing surface. Using its own modified form of sonar, the Grafbar detects with amazing resolution the location of its pen or cursor on any surface. Science Accessories claims a resolution of 254 lines per inch (0.1 millimeter) and accuracy of .01 inch, matching most conventional tablets.

The electronics and microphones are contained in the Grafbar control unit, an aluminum box measuring 1.8 by 19 by 6.5 inches (HWD). The microphones are visible on the front panel as small black bull's-eyes near either side of the front panel. Closer to the center of the front panel are two LEDs. The red one on the right is a power indicator; on the left, a green one is labeled "Menu." The Grafbar menu itself is unique. Black silk-screening on the gray-beige front panel denotes five control areas—zones that stretch about 4 inches in front of the control box—in which pressing a cursor or pen button will activate special functions. From left to right, these are labeled Origin, Point/Line, English/Metric, Stream, and Cancel.

Origin allows you to move the digitizing area almost anywhere on your work surface by relocating the origin of the Grafbar's coordinate system. Point/Line determines whether the tablet sends out data only when buttons are pressed at end points or continuously as lines in between presses. English/Metric controls the mea-

suring system used. Stream forces the Grafbar to transmit data to its host continuously. Cancel resets these options to their defaults.

The rear panel of the control unit is devoted to switches and connectors. A standard female 25-pin D-shell connector hosts the serial input/output signal (no serial cable is supplied by Science Accessories) while the odd proprietary connector links to the pointing device. One bank of DIP switches is used for system setup (including selecting cursor or pen). The control unit runs from ordinary AC, tapped through its 87-inch cable and power jack. A small toggle switch for power completes the rear-panel accoutrements.

A pen and two cursors (one-button and four-button) are available to complete the Grafbar system. Either the pen or the one-button cursor comes as standard equipment. The Science Accessories pen uses only a tip switch and can be equipped with standard ballpoint pen cartridges with ink or without.

Only the four-button cursor was shipped with the evaluation unit. A $170 option, it's basically a rectangular chunk of gray plastic measuring 0.9 by 2 by 3 inches (HWD) with a 1.4-inch clear extension paddle for the reticle cross hairs. Its four round buttons have their own unusual arrangement. One is a large, black pad about half an inch in diameter. Below it are three 0.25-inch buttons in blue, yellow, and orange. The one-button cursor has the

The $1,315 Grafbar GP-7 Mark II is the only sonic digitizer in this roundup. There is no tablet, so the unit occupies very little desk space, but because of its 27-inch proximity, it has the unique ability to work around obstacles anywhere on your desk.

same shape; it lacks only the second row of buttons.

The bottom of the cursor is finished with exactly the same plastic as the rest of the case; it has no special slippery surface. Its most unfortunate aspect is the 55-inch tail that drags behind it to connect with the control unit. The freedom afforded by tabletless operation makes you long for cordless operation as well. According to Science Accessories, however, no cordless models are planned because little demand exists.

The Grafbar works surprisingly well—surprisingly, that is, only if you're

FACT FILE

Grafbar GP-7 Mark II
Science Accessories Corp., 200 Watson Blvd., P.O. Box 587, Stratford, CT 06497; (203) 386-9978.
List Price: Tablet, $1,315, four-button cursor, $170.
Requires: Serial port.
In Short: A sonic digitizing system that turns any surface into a 25.5- by 23.5-inch tablet with moderate precision and average accuracy. The Grafbar's biggest problem is a severe shortage of software support.

CIRCLE 419 ON READER SERVICE CARD

not familiar with the technology. It proved able to identify the location of the cursor readily. Small objects between the cursor and control unit did not cause location difficulties, although the ultrasonic signals could be blocked with book-size objects in their path. When the signals were blocked, no errors resulted. Instead, the on-screen cursor simply did not move until signals were again available to the cursor.

Proximity is an odd issue when you're dealing with the Grafbar system. The range of the ultrasonics is roughly the same in three-dimensional space. That is, you can move the cursor in a horizontal plane away from the control box or move it vertically to effect the same displacement on the screen. In effect, the proximity is almost equal to the length of the active digitizing area, over 2 feet.

The active area will cover a great deal of your desktop, 25.5 inches wide by 23.5 inches long. Using the AutoCAD AD driver that was supplied with the system, the Grafbar produced a default active area of 15.5 by 17.25 inches, corresponding to the drawing space on the screen. The only other software driver provided is for

Microsoft Windows. You'll either have to write your own software or ensure that your application already has specific support for the Grafbar.

Overall, the Grafbar is as novel as it is useful. Line the bottom of the control unit with Velcro, and you can fix it on top of your drafting board or light table, move it around, and digitize on each surface. If you want flexibility in choosing where you work—and what you work on—the Grafbar is for you.

SCRIPTEL CORP.

SPC-1212 Opaque Digitizer
RDT Transparent Glass Digitizer

by Winn L. Rosch

Despite its logo, which looks like type that was pried off a 1950s coffee maker, Scriptel Corp. incorporates a number of innovative ideas into its line of tablets. Its products all use a unique and patented technology called resistive decoding. One line of tablets is crafted from glass and incorporates a clever integrated setup procedure and an eight-digit LCD readout. In fact, transparency is such an important feature of Scriptel's RDT series of tablets that the company's more-ordinary tablets are called SPC Opaque Digitizers, almost with a trace of disdain.

Currently, the $599 SPC-1212 Opaque Digitizer is the sole member of Scriptel's Designer Series, although similar opaque tablets are offered as its Animator Series, the 12- by 12-inch LCA4Z and the 12- by 17-inch LCA3Z.

A wedge of the future, the pale gray Scriptel SPC-1212 rises dramatically from its 1-inch front edge to 2.9 inches at the top, the sides swept in like the latest in Italian sports coupes. The 15.5-inch-wide surface itself is completely flat for most of its 16.5-inch height. Up top are the silk-screened Scriptel retroscript logo and two LED indicators.

The actual drawing surface is marked off by a thin, darker gray border. At the top, several square function-control areas are designated within the confines of this border. Actually, the drawing area that Scriptel designates is quite pessimistic. In testing, the active drawing area was found

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CIRCLE 294 ON READER SERVICE CARD

to extend an additional half inch to the right and a full inch higher than the markings.

Construction of the SPC-1212 rates as solid. Its bottom is a flat aluminum sheet, folded up around the rear panel and partly covered by the top of the case. At the back of the tablet expect to connect a Scriptel pointing device using a modular Berg connector as well as a power cord to connect the tablet to any standard 115-volt outlet. Two banks of DIP switches are used for setup. The 74-inch serial cord is not removable but terminates in a standard 25-pin D-shell connector.

THE RDT SERIES

As completely clear, see-through digitizing tablets, the entire Scriptel RDT series really stands out in both appearance and functionality. You can lay any one of them atop a blueprint or drawing and trace to your heart's content.

Each tablet is made from a quarter-inch sheet of heavy tempered glass with smoothed edges. Although the durability of the tablet was not tested, Scriptel reports

that the tempered glass shatters like the side window of an automobile, disintegrating into tiny pieces instead of sharp shards.

The RDT line is composed of five models varying only in size: 24 by 36, 20 by 20, 18 by 24, 12 by 18, and 12 by 12 inches. Prices follow size, from $4,195 at the large end of the scale to the $995 cost of the 12- by 12-inch tablet tested. The overall measurement of the smallest RDT tablet is 16.5 by 17.5 inches.

Each of the RDT series wears the same strange growth at the top, a sculpted medium-gray plastic block that contains the control electronics.

The expanse of glass is marked with several patterns. A border of silver Hs runs along about an inch outside the active pad area, a remnant of the resistive coating. The active digitizing area is somewhat inaccurately demarcated by a narrow black border. The actual active area extended about one inch to the right and one inch above the designated 12- by 12-inch area.

Centered on the glass above the normal digitizing area is a small, round-cornered rectangle that's outlined with a black border. Move your pointing device over this area, and the RDT's menu pops onto its eight-character LCD display in the tablet handgrip. System setup is accomplished by stepping through the menu with various presses of cursor buttons. While daunting at first, it quickly becomes a convenient process.

Power for the RDT is drawn through a bothersome outboard box measuring 2.5 by 3 by 7 inches. Two cords trail from it, a 7-footer that connects with a 115 VAC outlet and a 67-inch secondary cable that plugs into the tablet using a modular Berg connector. The serial communications cable, 74 inches long, is attached directly to the control electronics box and cannot be removed. The cable ends in a 25-pin D-shell connector.

Either a cursor or pen is included in the purchase price of a Scriptel tablet. As options, each costs $110. No pen was received for evaluation. The same Scriptel cursor, which the company calls a "Tracer" (for which Scriptel claims a trademark) is used by both tablets. The 2.5-inch-wide by 4.75-inch-long by 1-inch-high object is oddly shaped, to say the least. At its base it's a truncated pyramid that leads to a lower area with four buttons. Rubber chiclets, they seem to require inordinate force for activation.

Offset to the left above the keys is a 1.25-inch paddle holding the Tracer's reticle—X-shaped cross hairs outlined by a darker target. The bottom of the cursor is covered with black felt to make it slide easily. However, the odd shape and slippery plastic of the top make it one of the least desirable cursors, and one of the hardest to get a good grip on.

Besides the transparency of the RDTs, the biggest distinction of the Scriptel tablets is their wide range of compatibilities and data formats. Emulations accommodated by the SPC series in binary, ASCII/BCD, and remote programming formats include Scriptel, Summagraphics Bit Pad Plus, Summagraphics MM Digitizer

series, GTCO's Digi-Pad, Houston Instrument's HIPAD, and Hitachi's Tiger Tablet. The RDT series adds Summagraphics Bit Pad II and built-in Microsoft Mouse emulation as well. The wide range of emulations makes up for one noticeable shortfall of the Scriptel tablets. They include no software and no templates. You must rely on the emulations and the tablet support built into your applications.

On the SPC tablets, the emulation as well as the serial data format and reporting speed are all selected through DIP switches on the rear panel. RDT operational modes are selected through its integrated setup system.

The downsides of these Scriptel tablets are minor. Their resistive decoding technology proved to be more sensitive to metal objects on the digitizing surface than in other makers' digitizers. For example, a

The $599 Scriptel SPC-1212 Opaque Digitizer (top) and the $995 RDT Transparent Glass Digitizer (bottom) are strong performers. Both use Scriptel's unique and patented resistive decoding technology, but what makes the RDT models special is that they are made of glass—perfect for tracing anything you set beneath them.

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metal tape measure caused the sensed position of the cursor to vary by more than an inch. Any problems arising from this sensitive technology can be avoided simply by removing paper clips and staples before taping drawings to the Scriptel tablets.

While the glass tablet makes a good choice for tracing just about anything flat, the thickness of the glass does impose a parallax problem that may make precise tracing impossible. Parallax deviations are exacerbated by the four tiny vinyl feet that raise the tablet about a quarter of an inch above whatever work surface the tablet is put upon. Of course, you can trace transparent and translucent films (say medical X rays) and drawings without parallax by taping that art to the glass and resting the tablet atop a light table for illumination.

The novel technology used by the Scriptel opaque tablets does not make them stand out among their competition. Regard them as good performers that speak a number of languages. If the notion of a see-through tablet appeals to you, however, you have no other choice than a Scriptel RDT. They're good enough that you should have no misgivings.

Summagraphics has the most widely emulated and best-selling digitizing tablets. Both the SummaSketch II (bottom) and SummaSketch II Professional (top) are lightweight and fast. At $599 and $999 they're reasonably priced, considering the completeness of the packages.

SUMMAGRAPHICS CORP.
SummaSketch II
SummaSketch II Professional

by Winn L. Rosch

The best-selling digitizing tablet in the world, according to Summagraphics, the SummaSketch II has a lot going for it. It's compact, lightweight, fast, affordably priced, and benefits from the most extensive industry support of any tablet. A complete system, including input/output cable, power supply, pen, cursor, and software disk, lists for $599. Add "Professional" as a surname, and the tablet grows 50 percent in size and becomes 66 percent more expensive: $999 for the full kit.

Summagraphics is perhaps the oldest name in PC tablets, predating the introduction of IBM's first Personal Computer by nearly a decade. The company, started in 1972, launched the well-received Bit Pad One magnetostrictive tablet in 1975. The present series of electromagnetic tablets was first introduced in 1983. Known generically as the MM Series (the Summa-

Sketch II is more formally known as the MM1201; the Professional, the MM1812), Summagraphics tablets have used basically the same design and communications protocol and code since then. These have been popular enough that over 250 software publishers take advantage of them, and nearly every other digitizing tablet has some facility to emulate them.

Opting for the real thing will pay big dividends, however. Although the SummaSketch II weighs hardly more than 3 pounds, it gives a feeling of permanence, almost as if it were carved from a solid slab of plastic—no rattles, nothing loose.

Both the standard tablet and the Professional seem to have been made from the same mold. Both appear to be little more than a flat panel of gray-beige plastic on top, filled plastic on the bottom. Styling is plain and squared off. The SummaSketch II measures a comfortable 16.25 inches wide by 16.5 inches long by 1.75 inches thick, not much more than a tablet of draw-

ing paper. The Professional stretches out somewhat wider and an inch longer, measuring 23 by 17.5 by 1.75 inches (width, length, thickness).

One design aspect of the SummaSketch II that's so providential it might not have been intentional is the twin knee-relief areas on its underside. These two flat-sculpted areas add stability should you balance the tablet on your knees. It can be a godsend for finicky, artistic types (such as this author) who like to work with a digitizing tablet as if it were a sketch pad rather than with one that is immovably chained to a desktop.

The top surface of either tablet bears little decoration to break up its plainness, only the tablet name and a flashing green power/proximity indicator LED near the top edge. The LED normally flashes if a pointing device is not within range of the tablet's circuitry, turning steady when pen or cursor comes within operational proximity. As such, the LED gives a quick way of diagnosing problems. If it lights properly with pen or cursor movement yet your application doesn't agree, you know the tablet is working and you should check the communications cable.

The only other adornment on the tablet surface is a thin groove, as wide as a dime is thick, that exactly defines the active touchpad area—12 by 12 inches on the standard SummaSketch II and 18 by 12 inches (long axis horizontal) on the Profes-

sional. When you're using *AutoCAD*'s default setup and the standard Summagraphics ADI driver, having the larger tablet isn't an advantage. In this case both tablets provide an active area of 10 by 8 inches. The balance of the active tablet was devoted to menus. The Summagraphics MM driver built into *AutoCAD* does better and includes provisions for selecting the tablet size.

While the tablet itself has no mechanical provisions for holding down templates, it is amenable to masking tape. Summagraphics does not supply any templates but does include a coupon that can be returned to the company in exchange for one of the following four templates: *AutoCAD*, *Cadkey*, *VersaCAD Design*, or *Microsoft Windows*.

Both tablets deliver the same resolution, up to 1,016 lines per inch (the odd number works out to be 40 lines per millimeter), with an accuracy of 0.015 inch. Although the accuracy sounds subpar compared with that of tablets claiming 0.01 inch, for most applications it's not likely to make a practical difference. Both tablets also draw with equal speed, up to 116 points per second, more than enough to outrun *AutoCAD* even on a 25-MHz 80386 machine.

STYLUS AND CURSOR

What Summagraphics calls a stylus is actually a 7-inch pen, normally supplied with a nylon stylus tip. Inside you'll discover the all-plastic cartridge that dimensionally matches a ballpoint cartridge, should you need to turn the Summagraphics pen into a genuine pen with ink. Classed as a two-button pen, one button registers through a tip-activated switch; the other through a button near the tip of the pen. Overall, it has a good feel, comparable to wielding a fat technical pen. The pen is tethered to the tablet with a 1-meter cord that's limp enough not to interfere with normal use.

The 1.75- by 4.5-inch standard cursor sports a 1.25-inch clear plastic paddle, its cross hairs encircled by a wide band of thin wire coil to detect the tablet's signal. Its four buttons are arranged in a diamond formation. The black velvet bottom of the four-button cursor slides smoothly and easily across the tablet surface. The cursor, too, was tethered by a meter of very thin, limp cable.

A 16-button cursor is available and can be substituted for the four-button model when you buy the SummaSketch package.

The extra buttons add $100 to the price of either tablet.

Both of the Summagraphics tablets plug into their computer hosts through a standard serial connection. The 60-inch cable supplied with the system terminates in a 25-pin D-shell connector, but Summagraphics also supplies a 9- to 25-pin adapter for ATs. The D-shell connector itself also provides the linkup to get power to the tablet. A small external transformer plugs directly into a standard wall outlet and supplies the electricity the SummaSketch requires through a 4-foot wire that plugs into the 25-pin connector. At the other end, the serial cable ends in a modular connector for plugging into the left side of the back of the tablet. The cursor or pen plugs into the other jack on the right.

The firm includes some software with either SummaSketch II system: an *Auto-*

> With the proper choice of pen from its diverse line, Wacom tablets are the top choice for artists.

CAD driver, a universal mouse emulation driver (compatible with Version 6.13 of the Microsoft mouse), a *Windows* driver, a reset utility, and a test utility. According to Summagraphics, the tablets work with all versions of *Windows* after 2.03 including *Windows/386*.

The Summagraphics system has several strengths. The SummaSketch tablets are packaged as complete bits, including everything you need to instantly get into operation. Complementing that is the extensive industry support of the MM data format that makes the SummaSketch series compatible with more programs than almost any other tablet (except, of course, other tablets that also use the MM format). And the SummaSketch tablets are just plain good—solidly built and good performers. The only additional thing you could ask for would be a cordless cursor or pen. If that's not an issue for you, you'll be delighted with the SummaSketch II.

WACOM
Wacom SD-322L
Wacom SD-420L
Wacom SD-421L

by Winn L. Rosch

Like Kurta, Wacom cuts the cord and brings freedom to digitizing. Using a novel technology, the entire line of Wacom tablets works without wires to pen or cursor and without batteries, yet the entire system works smoothly and without errors. With the proper choice of pen from Wacom's diverse line, the company's tablets rate as the top choice for artists.

A newcomer to the United States, Wacom has been selling magnetostrictive tablets in Japan since 1983. Its unique give-and-receive magnetic resonance technology was developed in 1987 and first went on sale in the United States with FCC Class A approval in January.

The give-and-receive resonance system relies on the energy that's briefly stored in resonant circuits. The electromagnetic field in the tablet itself excites an LC circuit (one that combines an inductive coil and a capacitor) in the pen. The inductive coil does double duty and also serves to electrically couple the pointing device with the tablet. When the circuit discharges, the resulting signal flowing through the coil is picked up by a matrix of flat-wound coils in the tablet. The relative strength of the signal in tablet coils helps determine the location of the pointing device.

Pressing a button on the pointing device alters the tuning of its LC network, and the resulting change in phase angle can be detected by the tablet. Because the LC circuit in the pointing device is entirely passive, no batteries or other power source (besides the current induced from the tablet) is necessary for its operation.

The current line of Wacom electromagnetic resonance tablets embraces six different model series, all of which use the same technology, but only three of which are imported to the U.S. Of these six series, PC Labs examined three separate models representing two different tablet sizes and three different working surfaces. The SD-320 series, represented here by the $1,345 SD-322L, is the larger of the two, with an active area that measured 16 by 16 inches, in excess of the conservative 15- by 15-inch claim of the manufacturer. The $795

SD-420L and the $895 SD-421L yield active digitizing areas measuring 12 by 12 inches. The prices include only a modest amount of software but do not include pointing devices, which must be purchased separately.

All of Wacom's tablets proved large and heavy for the digitizing areas they yielded. The weight penalty is not a result of the technology used but related more to the tablets' construction. These are built to be industrial-strength tablets; they contain sheet steel inside as shielding. In addition, the Wacom tablets put the entire power supply inside—that means you just plug them into the wall without an external transformer. The transformer resides inside the tablet, adding to both its volume and mass. The SD420 series tablets weigh nearly 10 pounds; the SD-320 series, nearly 15. These are not tablets that you can rest on your lap.

Note, too, that although the pointing devices used by the Wacom tablets are cordless, the tablets themselves are not. Each one requires two cables to be plugged in—power and signal. The signal cable handles only serial data and connects with a standard RS-232C port—the only interface supported by the Wacom system. The one shipped with the tablets by Wacom was 80 inches long and featured a 9-pin D-shell connector at one end for attaching the tablet and a 25-pin D-shell at the other for your computer. Wacom also supplied a 9-to-25-pin adapter.

The SD-420 series of tablets are flat wedges measuring 16.5 by 16.5 by 3 inches, sloping down to less than an inch at the front edge. The corners and edges of the generally square tablet are gently rounded. At the upper left, three LEDs indicate system functions: a power-on indicator, a ready light (indicating that the pen or cursor is within proximity), and a status light (indicating switch activation).

The SD-320 series conforms to the layout and shape of its smaller sibling. The principal difference is its size, necessarily larger to accommodate more digitizing area. Overall, it measures 20.75 inches square and about 3.5 inches high.

Under AutoCAD's ADI driver, the two smaller tablets fit the on-screen drawing space into a 9.5- by 10.25-inch digitizing area on the tablet, about the same as most tablets their size. The larger SD-322L tablet yielded a 12- by 13-inch range that corresponded to the AutoCAD drawing area.

According to Wacom, the resolution of either series of tablets is a sharp 1,270 lines per inch (50 lines per millimeter) with an accuracy of .01 inch. Either tablet is capable of drawing 205 points per second, more than enough to operate smoothly with AutoCAD.

Either size of tablet is available with one of three working surfaces, designated by the final numeral in each model number. A final digit of 0 indicates a conventional digitizing surface, termed "plain" by Wacom. The same white-beige as the rest of the tablet, the slightly textured plastic surface is otherwise unremarkable except that the active area is in no way delineated from the rest of the tablet surface.

A final 1 in the model number indicates an "adhesion plate" surface. At first glance, this series of tablets appears only to have changed the color of the active area to black, which at least lets you know the bounds of the system's digitizing abilities. Flip a switch hidden under the left edge of the tablet, however, and a magical transformation occurs. Any paper that's on the

digitizing area suddenly clings to the tablet. Once the switch is flipped, paper sticks to the surface and won't move unless you peel it up. This unique feature generated many oohs and aahs from onlookers in PC Labs.

The secret is static electricity. The switch controls an internal power supply that puts a 2,000-volt charge under the drawing area that holds paper down the same way balloons stick to sweaters.

The third choice, with a final 2 in the model number, is a "menu panel" tablet, which uses a removable transparent panel to cover the drawing area. The idea is to allow you to put your templates safely and

Wacom is Kurta's only rival in the cordless digitizing arena. Pictured here from left to right are the $1,345 Wacom SD-322L, the $795 Wacom SD-420L, and the $895 Wacom SD-421L. The Editor's Choice SD-421L has an innovative electrostatic generator that holds any draft paper firmly in place while you draw or trace.

immovably under this panel. A transparent silicone-rubber suction cup allows you to lift the 0.12-inch-thick plastic panel to change templates or menus. The slightly textured finish of the panel resembles ground glass and reduces glare. In testing, the sheet did not alter the proximity range of the Wacom pointing devices.

POINTING DEVICES

Five pointing devices are available, all as extra-price options. Four of the choices are pens. All are cordless and operate without batteries or any power other than what they pick up from the tablet.

Two of these are pressure pens, priced at $125 each. As the name indicates, they rely on the pressure applied to their points to indicate the amount of force applied to the pen tip. Although sent to the host system in digital form, the pressure actually represents an analog value that can be used by software to control the width of a drawn line or simulated brushstroke.

The two pens differ in the force required for activation; a green band around the pen indicates the model SP-300, which responds to higher pressure (up to 500 grams), while the red band of the model SP-310 denotes the lighter touch (0 to 300 grams) it responds to. The pressure pens proved nearly unworkable with AutoCAD 10. Since they seem to have no proximity, the slightest interruption of pressure causes menus to pop onto the screen. The problem results from a bad interaction of the pressure data, the Wacom ADI driver, and AutoCAD. However, the pressure pens come into their own with drawing programs. They have a real pen feel when you're drawing lines, and they offer 256 discrete pressure levels.

According to Wacom, the pressure pens are the first ever to operate cordlessly. They use a variable ferrite inductor, controlled by pen displacement, to alter the resonance of the tuned circuit in the pen. From this change, the tablet electronics can accurately calculate the pressure applied to the pen point.

Wacom's standard pens function more conventionally, although still cordless. An elongated button complements the internal switch that registers when you press down on the point. A gray band indicates the model SP-200 nonstroke pen—there's virtually no downward motion required to activate the switch. A red band designates the SP-210 stroke pen, which requires short but definite travel to activate the tip switch. The proximity range of the two

There are very few reasons not to buy a cordless tablet. The freedom gained by cordlessness can be invaluable, especially to freehand artists. The Kurta IS/ONE, a former Editor's Choice and winner of a 1988 PC Magazine Award for Technical Excellence, has yet to be upstaged by the competition. Even at $995, it's a high-quality bargain.

The Wacom SD-421L also features cordless pointing. Its special feature is its electrostatic surface that makes papers cling to it while you work. At $895, it's pricier than much of the competition, but its construction quality is excellent, and the availability of an optional $125 pressure pen should cause artists to take note.

Of the corded tablets, the $895 12- by 18-inch Houston Instrument HIPAD Plus 9018 scores high marks for its excellent resolution (2,540 lines per inch) and data transfer speed (38,400 bits per second).

The $599 Summagraphics SummaSketch II remains the quintessential general-purpose tablet for all-around use. It is light and complete, and as the de facto industry standard, it's compatible with more application software than any other tablet. Keep in mind that several of the tablets evaluated here are outstanding for specialized applications but are less effective as general-purpose instruments. The Scriptel RDT glass tablet is a good example.

Wacom switched pens was limited to about 0.25 inch with AutoCAD, but they nevertheless proved quite workable. Either pen costs $80.

All pens are about 5.75 inches long. Wacom supplies pen holders and a pocket clip with each tablet. The pens are packaged in lush boxes, exactly what you'd expect for a premium pen-and-pencil set in their price range.

Wacom also offers a $150 cordless

four-button cursor. Measuring about 3.25 inches long (the reticle paddle adds 1.25 inches) and about 2 inches wide, it's semi-streamlined and easy to grab while keeping the buttons under your index finger.

INSTALLATION
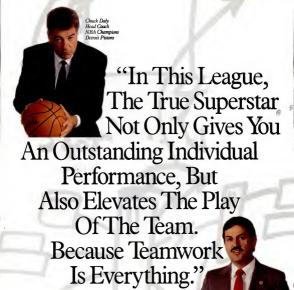
Installation of the Wacom tablets at first appears confusing because of three banks of DIP switches on the rear panel of each tablet. For the most part, these switches establish communication parameters for the tablet's serial port. On the positive side, the function of each switch is well documented, and no adjustment is likely to be needed for normal operation. The switches become bothersome, however, when you want to change emulation modes. Each of the three modes requires slightly different switch settings.

Software installation for normal operation is minimal. A test program verifies the correct operation of the tablet electronics (although at the time of evaluation, the Compaq Deskpro 386/25 test-bed found some timing problems in the software that resulted in nonexistent errors being reported). The only additional step is to select an emulation using the WMODE program. Summagraphics Bit Pad II, MM1201, or Wacom II command sets can be selected with command-line options.

Drivers are provided to allow the Wacom tablets to emulate the Microsoft Mouse for use with Windows/286 or GEM. At the time of evaluation, no software for Windows/386 was available, although Wacom believes it will be able to offer it by the time this article appears. An AutoCAD ADI driver is also supplied.

Cordless operation alone is enough to recommend the Wacom system. But even if cordlessness doesn't matter to you, the optional tablet surfaces make the Wacom tablets desirable. For drawing programs, the pressure pens are unmatched, approached only by Numonics' ZedPEN and CalComp's DrawingBoard 2300 with its optional external box (neither of which, of course, is cordless). The only drawback to the Wacom system is the weight of the tablets themselves. If you're looking for a tablet that will stay in place on your desk and give you the freedom to work the way you want to, you'll want a Wacom. For the most convenience, the Wacom SD-421L, which keeps your paper in place, is the pick of the litter. ∎

Frank Bican and Winn L. Rosch are contributing editors of PC Magazine.

Chuck Daly
Head Coach
NBA Champions
Detroit Pistons

"In This League,
The True Superstar
Not Only Gives You
An Outstanding Individual
Performance, But
Also Elevates The Play
Of The Team.
Because Teamwork
Is Everything."

Bill Thompson
Director of MIS
The Sherwin-Williams Company
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**BUILDING
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LAN Management Systems

**Every good LAN deserves
quality management and
monitoring facilities.
One possible solution:
a sophisticated

network management
and control package
from Cabletron Systems,
Proteon, or Synoptics
Communications.**

by Frank J. Derfler, Jr.

LAN management systems hold a special place in the world of
networking software. Unlike the accounting, database, e-
mail, and workgroup productivity packages reviewed in this
issue, these products are designed only for the network man-
ager. None of these systems sends communications across a
network, and one of the products doesn't even have to run on a
PC. Their function is to provide the manager with a great deal
of control over network activity by gathering data from spe-
cial wiring hubs at the geographic center of the LAN.

The field of network management systems is confusing,
primarily because network control and reporting take place at
so many levels. There is a hierarchy of devices and programs
at several levels reporting status and problems upstream to an
overall data-gathering and reporting system.

The lowest level of network reporting devices consists of
hardware with internal microprocessors and programming.

HOW LAN MANAGEMENT SYSTEMS GATHER INFORMATION

Each PC in this generic network has a direct link to a wiring hub. The link between the PCs and the hubs is made over twisted-pair, token-ring, or fiber-optic cabling—whatever is appropriate to the network adapter cards and connection modules in the hubs. Connections between the hubs might be made by fiber-optic cable to increase the permissible distance and reliability, regardless of the type of cable used between the hubs and PCs.

Each hub contains an internal microprocessor, along with a program that gathers data on network traffic and can use the hub's components to disconnect nodes under certain conditions.

Some systems transmit management data between hubs using the network wiring. Other systems use a separate wiring path, or modems, as a means of connection between the hubs.

A specific PC on the network runs the reporting and control software that gathers information from the wiring hubs. This PC can communicate with all hubs, not just the one to which it is attached.

Workstation (or server)   Workstation   Workstation   Workstation

PC with management and control software

Twisted-pair, fiber-optic, or token-ring cable

Fiber-optic or network cable

To other hubs

Wiring hub with microprocessor augmentation

These devices include LAN wiring hubs, bridges, multiplexors, microwave radios, and modems. Their internal processors and programs gather statistical information and send out status reports to some intermediate level of software, usually running on a PC. If the network is not large and is composed of relatively homogeneous parts, these systems might provide all the analysis a manager needs.

The LAN operating systems in printer and file servers can also send alerts and notifications to higher-level management programs. At the highest level, management and control programs will accept alarms from any reporting device that can send them along in the right format; for instance, application programs can complain to management programs about files that they can't find or access. The reports from all these levels of hardware and software must be in some common format so that one top-level system can compile them and present them to users.

There are competing grand architectures for network management and control, marketed by companies such as IBM, DEC, Hewlett-Packard, and AT&T. At the same time, there is an attempt to standardize network management protocols and procedures within the International Standards Organization itself.

This review concentrates on the lowest-level smart reporting devices and the programs that gather their reports. Though these systems reside on the lowest level of the stack, they provide a great deal of information. These packages are uniquely independent of the LAN operating system software and soon will fit into most of the grand management-architecture schemes. If LAN control and management are important to you now, or if they will be in the next few years, you should invest at this level first. It's one LAN decision that you have to make early.

ALARMS AND ACRONYMS
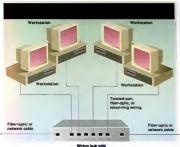
The whole network management and control industry has one common trait: reliance on the principle of performance alarms. When you use alarms, you're instructing the software to call your attention to any abnormal event. It's up to you to define the limits of abnormality—more than 30 consecutive Ethernet packet collisions, for example, or an unusually small or large number of packets sent within a specified period of time. The network management and control software packages' responses to alarm situations range from silently logging the event to frantically flashing sym-

bols on the screen and beeping while sending error messages to a printer.
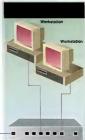
Of course, a blizzard of inevitably complicated acronyms surrounds the highest level of network management architecture. Picture these architectures as the underlying scheme you might use to plan a network management control center that looks like a small version of NASA's Mission Control. These architectures are particularly suited to big networks, which might need the highest level of reporting and the increased detail they can provide. However, big networks are made up of a lot of little networks with many nodes—most of them PCs. Each of the nodes in all of the little networks has to report to the big system. Like so many other things in the PC arena, there are several solutions: the ideal for which everyone hopes, a system that is working today in government and university networks, and IBM's own unique approach.

ALL ABOUT ISO CMIP

The management structure that everyone is hoping for comes in the form of an emerging open architecture called the Common Management Information Protocol, or CMIP (pronounced see-mip). The International Standards Organization (ISO) is cur-

rently working on the CMIP proposal. Major companies such as Digital Equipment Corp., AT&T, Hewlett-Packard, and Northern Telecom say that they will release network products that follow the established CMIP protocols.

The ISO draft standard primarily defines the functions of network management software and explains how reports are formatted and transmitted. The standard also describes the format of the messages sent to devices trying to connect or isolate error conditions. The functions that the ISO model defines include the following types of network management: fault, configuration, performance, security, and accounting. The other models described below agree with these definitions in general terms.

Fault management includes detecting problems and taking steps to isolate them. Configuration management provides messages to describe active connections and equipment. It is closely tied to fault management, because the primary way to isolate network faults is to change configurations. Performance management includes counting things like packets, disk-access requests, and the number of times specific programs are used. Security management involves alerting managers to unautho-

rized access attempts at the cable, network, file server, and resource levels. Accounting management involves billing users for the applications and data that they access.

The announcements from Digital Equipment Corp. bill the company's planned CMIP-compatible network management system as the Enterprise Management Architecture. AT&T calls its system the Unified Network Management Architecture (UNMA). The first product released under AT&T's UNMA, and the first real CMIP product on the market, is the Accumaster Integrator.

CMIP is a great idea, but the protocol is still evolving. It will be a year or more before many practical products that support it hit the market.

IN THE MEANTIME

Since the need for a LAN control and reporting system has existed for a number of years, people have solved the problem in several ways. The control and reporting system used on-line today in many major networks is called the Simple Network Management Protocol (SNMP). SNMP was developed and is used by the same Federal government and university community that brought us TCP/IP and its

suite of protocols (see "Building Workgroup Solutions: TCP/IP for Multiplatform Networking," *PC Magazine*, June 27, 1989). SNMP works well in the large defense and commercial networks that use TCP/IP, and there are plans to evolve SNMP products into CMIP products. Proteon, whose *TokenVIEW-4* product is reviewed here, also markets *OverVIEW*, a high-level data-gathering network management system for MS-DOS that gathers SNMP reports.

IBM's unique network management products debuted in early 1986. The overall system is called NetView, and the architecture relies on PCs running *NetView/PC* software to gather data on the network and to report to the NetView program running on a mainframe. Perhaps because the first version of *NetView/PC* required that a computer be dedicated to reporting on every network, or perhaps because NetView itself requires considerable mainframe resources, *NetView/PC* did not capture a large part of the market. IBM now markets a version of the *NetView/PC* software that requires OS/2 and that can collect data from several networks. IBM has also announced plans to evolve NetView to comply with CMIP sometime in the 1990s.

BACK DOWN TO EARTH

Since most people don't need a network management system that NASA could use to control deep-space probes, we have excluded such systems from our review. We have also bypassed the statistical and security-related network management utilities contained in network operating systems like Novell's *NetWare* and Banyan's *VINES*; these utilities don't tell you much about the activities of remote printers, communications gateways, mail servers, database servers, routers, and other devices on the LAN. If you want a full picture of the activity and health of a network, you have to go to the lowest common denominator: the physical layer of network cabling.

The products we've looked at rely on a centralized wiring hub to monitor and report on the status of network nodes. From its central vantage point, a wiring hub sees

> For larger networks, the per-node cost of LAN management software is very small.

every node and can measure the number and quality of packets that the node sends. The on-board processors in these hubs work with software running in a PC to report on and control—mainly by disconnecting—all network nodes. Although our tests showed that none of these programs were able to send alerts to high-level programs, that capability should be available in the future.

These packages use a variety of different wiring schemes. Proteon's system works only with Token-Ring networks. The products from Cabletron Systems and Synoptics Communications use twisted-pair or fiber-optic wiring, or a combination of the two. Synoptics plans to expand its system to include Token-Ring and thin Ethernet by late 1989. If you want to run similar software on a Macintosh, Farallon Computing of Berkeley, California, markets *TrafficWatch*, which reports on and manages networks using Apple's LocalTalk architecture.

As soon as we set up these systems in the PC LAN Labs, it became clear that

NETWORK MANAGEMENT: A Short Glossary

CMIP Common Management Information Protocol. A structure for formatting messages and for transmitting information between reporting devices and data-collection programs. Developed by the International Standards Organization and designated as ISO 9596.

Concentrator See *wiring hub*.

EMA Enterprise Management Architecture. Digital Equipment Corp.'s company-specific architecture conforming to ISO's CMIP.

FDDI Fiber Distributed Data Interface. A specification for fiber-optic networks operating at 100 megabits per second. FDDI uses wiring hubs, and the hubs are prime candidates for network monitoring and control devices.

IEEE 802.3 10Base-T An evolving IEEE standard describing 10Mb-per-second twisted-pair Ethernet wiring. This wiring requires a wiring hub and is useful for installing network monitoring and control devices.

NetView IBM's company-specific network management and control architecture. This architecture relies heavily on mainframe data-collection programs but also incorporates PC-level products running under OS/2.

ONMS Open Network Management System. Digital Communications Associates' company-specific architecture conforming to ISO's CMIP.

OverVIEW Proteon's company-specific architecture conforming to CMIP.

SNMP Simple Network Management Protocol. A structure for formatting messages and for transmitting information between reporting devices and data-collection programs. Developed in collaboration by the Department of Defense, industry, and the academic community.

Token-Ring A wiring and signaling scheme sponsored by IBM and adopted by the IEEE as its specification 802.5. Token-Ring uses wiring hubs that serve as logical points for centralized management. IBM does not implement management and control through these hubs, but Proteon does through its ProNET-4 product line.

Twisted-pair Ethernet See *IEEE 802.3 10Base-T*.

UNMA Unified Network Management Architecture. AT&T's company-specific architecture conforming to ISO's CMIP.

Wiring hub A cabinet, usually mounted in a wiring closet, that holds connection modules for various kinds of cabling. The hub contains electronic circuits that retime and repeat the signals on the cable. The hub may also contain a microprocessor board that monitors and reports network activity. ∎

Synoptics has everyone beat in the areas of user interface and flexibility. Although its lack of a Token-Ring connection provides Proteon with a clear lead in that area, Synoptics is trying to close the gap quickly. The Synoptics software we saw does not forward alarms to higher-level programs, but it should be compatible with IBM's NetView by this fall.
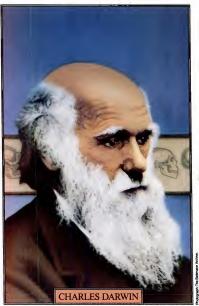
COST FACTORS

It is difficult to break down the added incremental cost for network management capabilities in these systems. If you use the wiring hubs (or "concentrators," as they are sometimes referred to) from these companies, the hardware will include major elements of the network management features. Additionally, while the initial cost

for software and hardware is usually several thousand dollars, that single cost is amortized over all of the nodes you now have and those that you will add in the future. Since larger networks usually benefit most from network management and control, the per-node cost is typically very small.

By themselves, these products provide all of the network management and control that many organizations will ever need. But if you think your network will grow with multiple servers, gateways, bridges, and wide area connections, you'll soon find yourself thinking about adding more layers of reporting. Looking for CMIP or SNMP compatibility in all of your network components is a smart idea, but starting to install reporting and control now at the lowest hardware layer is no less crucial.

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G/X25 Gateway is a high-speed multiuser LAN gateway providing information sharing with remote mainframes, minicomputers, service bureaus, or remote X.25 PCs. The gateway also features 20 different terminal emulators.

G/Async Gateway provides multiuser asynchronous connections between a NetWare-based LAN and remote asynchronous devices. G/Async Gateway features support for up to 15 of the most popular asynchronous terminal emulation packages.

G/SNA Gateway is a multiuser LAN-to-IBM mainframe link. It features both 3270 and 3770 emulation, so network users can quickly and efficiently execute on-line inquiry and batch processing with the SNA mainframe.

G/Remote Bridge provides synchronous remote connections between any Advanced NetWare LANs, regardless of the LAN topology or manufacturer. Transmissions are flexible and fast, at speeds up to 64 kbps.

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LattisNet Network Management System

Synoptics Communications has put a lot of effort into the development of LattisNet, a family of LAN connection devices that uses twisted-pair wiring or fiber-optic cabling and operates at 10 megabits per second. Along with AT&T, Hewlett-Packard, and other companies, Synoptics is in the forefront of the IEEE's work to develop the 10Base-T standard for fast twisted-pair networks.

LattisNet is a success in the market, with over 150,000 nodes installed in the last 2 years. One appeal of LattisNet is the detailed management and reporting capability provided in the *LattisNet Network Management System* (LNMS). The *LNMS* runs in one dedicated PC under *Microsoft Windows* and receives status and performance data from several different models of network hubs, called concentrators. (Under a plan Synoptics calls the Network Utility Architecture, 4- and 16Mb Token-Ring connections and thin Ethernet connections will be added to the LattisNet product line late this year. The management software to report on and control these connection schemes is scheduled for release in early 1990.)

LattisNet concentrators are composed of several pieces of hardware; Synoptics provides a choice of cabinets, each containing a different number of slots and the appropriate power supplies. A single System 3000 Network Concentrator can connect up to 132 nodes. Smaller units provide economical connections for department-size networks or subnetworks at a price of approximately $130 to $150 per node.

SLIDE-IN CONNECTIONS

Each concentrator cabinet accepts the same family of 10- by 14- by 2-inch slide-in modules that provide connections for the nodes over twisted-pair or fiber-optic cable. These slide-in modules connect and translate between the different wiring and signaling schemes so that network planners can mix and match media to make custom-tailored systems. In addition, each module in the LattisNet system has an array of status lights that gives a visual representation of the present activity. Similar modules will integrate thin Ethernet cable into LattisNet concentrators by the end of the year. Connections for the 100Mb-per-

second FDDI (Fiber Digital Data Interface) are planned for early 1990.

The heart of the LattisNet system is a device called the Network Management Module, which works in a concentrator and carries its own 80186 processor. The processor gathers data and sends packets to the board and to software running in the system management PC. Because the concentrator using the Network Management Module must maintain a connection to other concentrators and to the PC running *LNMS* when the network is down, the Network Management Module can also call the PC and other concentrators over a modem. You can buy the Network Management Module with either a built-in internal modem or with an RS-232 port for an external modem.

SCREEN GEMS

The display screen of the system management PC is certain to become a must-see stop on every VIP tour of your facility. Even if people don't understand the details of what they are looking at, the *LNMS* screens are impressive.

What's more, for the network manager and troubleshooter, the *LNMS* screens are valuable tools. The primary system display shows a diagram of the network; it

portrays each LattisNet concentrator and every module and connection in it. The program doesn't even require that you enter the details of the network into a database to build the diagram. The software uses the network to interrogate each concentrator, gather its status on a second-by-second basis, and create the screen presentation from that current information base. If a person doing repairs on a concentrator across the campus changes a module or

With over 150,000 nodes installed in the last two years, LattisNet owes much of its success to impressive screens, intelligent troubleshooting, and a clear and flexible path for growth, all for about $130 to $150 per node.

What better way to run Novell's 386 NetWare.

Novell's new 386 NetWare® will do for networking what gunpowder did for negotiating leverage. Provided you've got a 386 machine that's designed to be 100 percent compatible with it.

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NETWORKING vs. NOTWORKING.

Both the Samsung 386AE and PCterminal/286 have been tested exhaustively by Novell for compatibility with popular networking hardware and NetWare products. In fact, no other LAN hardware

has ever undergone such extensive testing.

But then Samsung and Novell didn't set out to design just another make-do desktop computer.

Samsung's 386AE Fileserver, for example, was designed from the bus up to be a high-performance fileserver, starting with its Novell-developed BIOS. It also sports eight expansion slots for the inevitable inventory of interface and controller cards. Plus an oversize power supply capable of driving the requisite 100 megabyte-plus hard disk, tape backup system, etc. And it includes 4 megabytes of high-speed RAM for disk caching.

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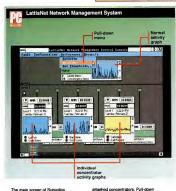
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SAMSUNG

LattisNet Network Management System

The main screen of Synoptics Communications' *LattisNet Network Management System* includes a histogram depicting activity through a concentrator and icons showing the

attached concentrators. Pull-down menus provide a way to call for more detailed information on any concentrator—or on any node attached to one.

disconnects a cable to one node, you will see the change on-screen within 5 seconds. To add English names to each node, you can supplement the database the program creates, but the program does most of the real work.

An eye-catching part of the screen presentation is a histogram showing activities going through each concentrator. This marching display is particularly useful for pinpointing very busy sections of the network that may need more connections or an intelligent bridge to isolate them from the rest of the LAN.

While the histogram is intriguing, other screens are spectacular. If you use a mouse or the keyboard to place the cursor over a particular concentrator on the on-screen diagram of the network and then select it, a complete diagram of the concentrator with all its modules is created, including a sec-

ond-by-second update of the status lights on each module. If you make a similar cursor choice on a single port of the concentrator, you can select displays showing the number of good, misaligned, undersized, late, and colliding packets. You can display the activity of several nodes at the same time, so you can do sophisticated things like checking the flow of data between a workstation and a gateway.

LONG-TERM ANALYSIS

The screen display gives you a very complete picture of the present status of the network and its subelements. For longer-term analysis, *LNMS* provides the ability to collect raw statistical data as well as the programming necessary to create a predefined series of reports. The reports include half a dozen pie and bar charts showing performance and out-of-tolerance operation.

These reports are created as ASCII files so that you can pass them on to more-sophisticated database programs. Synoptics Communications also provides many standardized reports.

In the area of control, none of these media-level systems can do anything more than disconnect a node from the network, but *LNMS* at least gives you the option of doing so politely. You can disconnect a node after a notification message or with-

> The media-level systems under review can disconnect a node. *LNMS* at least can do so politely.
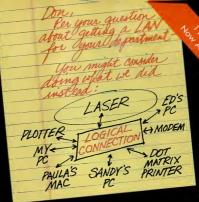
out notification, or you can arrange for automatic disconnection if certain criteria—such as a dozen packet collisions in a row—are met.

The one area in which Synoptics does not lead the competition is upward reporting. Just like the other systems reviewed, Synoptics' software didn't report events to any of the higher-level connection programs. However, *LNMS* should be able to report to NetView this fall. The company is also waiting for the final definition of the CMIP standard, which its product should support by early 1990.

The Synoptics LattisNet architecture provides a clear and flexible path for growth. The software gives spectacular views of the network and the activity down to the level of each node. Synoptics has a strong base in *LNMS*; the product's evolution should be interesting to watch.

Remote LANView-PC

Remote LANView, from Cabletron Systems, is one of the few software products we have ever evaluated that doesn't have to run on or even directly connect to a PC. You can connect a terminal compatible with DEC's VT220 directly to Cabletron's MMAC (MultiMedia Access Center) and use the internal microprocessor and program in the MMAC to view and control

Caution: Most local area networks gobble up huge amounts of RAM.

Some folks invest in a network, then find out it uses so much RAM they can't run important applications programs—like wordprocessors, databases and spreadsheets.

That is, unless they're willing to spend hundreds more per network computer on extended memory boards. And the programs to run them.

May we suggest a much simpler, far less expensive alternative: Artisoft's LANtastic.

LANtastic uses less than 40K of RAM on a server and under 12K on a workstation.

And that's an amazingly small amount of RAM! Especially when you consider that LANtastic delivers DOS 3.1 file and record locking, two levels of security, printer sharing, disk sharing, file and program sharing, audit trails, NetBIOS-compatibility, CD-ROM support and much more.

And because of LANtastic's tiny RAM requirements, you can run its network operating system in base memory and still have plenty left over for your programs.

Best of all, the LANtastic Network Operating System is available with 2 Mbps adapters ($249/node), Ethernet adapters ($349/node), in a serial and parallel port version, and in an adapter-independent version that runs on other manufacturers' adapter cards.

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Cabletron Systems' *Remote LANView-PC* relies more on alarms than statistics to report on the status of network activity but will still provide many basic management and control functions at a low cost.

the activity of that hub. Of course, if you don't want to buy a DEC-compatible terminal, you *can* use a PC to control the activities of a single MMAC. However, if you want to monitor and control the activities of up to 40 MMACs in a network, you need to run Cabletron's $1,995 *Remote LANView-PC* software on a 286- or 386-based PC.

The Cabletron network system is designed around twisted-pair Ethernet cabling. This system, like Synoptics Communications' LattisNet, uses transceivers that attach to the rear of almost any Ethernet adapter and convert the standard Ethernet transceiver connection to twisted-pair. While you can use any one of the many types of PC Ethernet cards in the nodes, the computer running the *Remote LANView-PC* software must have a 3Com 3C503 EtherLink II adapter from 3Com Corp. installed. A hard disk is optional but recommended, and the machine should be equipped with 512K RAM and an EGA monitor.

The Cabletron architecture provides connections for both twisted-pair Ethernet and fiber-optic cables in the same concentrator. The company markets several different concentrators and connections mod-

ules so that you can create economical wiring schemes. The high-end MMAC 8 hosts up to 84 twisted-pair or fiber-optic connections. The MMAC 3 is sized for 24 such connections. The average price per

Cabletron's various concentrators and connectors let you create economical wiring schemes.

connection is around $380, plus the cost of an Ethernet adapter card.

The screens created by *LANView-PC* are tabular instead of graphic, probably because Cabletron Systems' designers are oriented toward mainframe computers and attached terminals. The screens show an efficient set of yes/no options and parameters, but they are a far cry from Synoptics' spectacular displays.

ANALYZERS VS. MANAGERS: An Important Distinction

by Frank J. Derfler, Jr.

Some people think of protocol analyzers, like Network General's well-known *Sniffer*, as LAN management systems. However, *PC Magazine* classifies these devices as tools for system developers, not LAN managers. Protocol analyzers that capture and decode packets provide some of the same information available through management and control systems, but you have to work much harder to get that information *and* you lack the big-picture view that you get with management and control systems. In addition, since the management and control systems that operate at the network cable level don't decode packets, they present no risk to the security of data or passwords.

Protocol analyzers have a role in organizations where users develop sophisticated software and network hardware, but management and control systems have a role in almost every network. People who use protocol analyzers in place of network management and control systems are using a telescope to view a football game from the sidelines. They can read the quarterback's lips, but they miss a lot of the action. ∎

ETHERNET COMMUNICATION

The processors in the MMACs and the monitoring PCs communicate over Ethernet. In the event that the main cable should fail, there is no backup connection mode available. *Remote LANView-PC* polls the MMACs according to their Ethernet node addresses and, depending on the network activity, can take 20 to 30 seconds or more to query an MMAC and retrieve the current data.

In contrast to the other programs we reviewed, *Remote LANView-PC* relies more on alarms than on statistics. While Proteon's *TokenVIEW-4* and Synoptics's *LNMS* give you some idea of the activity level and operational status of the network

in real time, *Remote LANView-PC* focuses more on reporting by exception. You manage the network on an MMAC-by-MMAC basis; there is no way—except through an after-the-fact analysis of log records—to see an overview of network status and activity.

The software would be improved if it could better differentiate among the types of events that fall into the error category. The error-packet count can result from a number of things, such as collisions and undersized or oversized packets. It isn't extremely difficult to offer such differentiation, and a manager would certainly benefit from knowing whether a problem is the result of a collision or of a less common event.
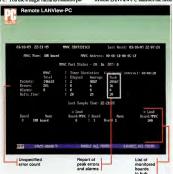
On the positive side, it doesn't take much work to set up *Remote LANView-PC*. You use a single menu to establish pa-

rameters, such as how often you want the PC to update its status and how many times it should retry failed network connections. On the negative side, the primary output of this system is an ASCII log file; the program doesn't provide a way to create specialized reports from the data in the file.

Remote LANView-PC satisfies the need

	MMAC		Time Statistics		Interval	00:00:20
	Total	Elapsed	Average	Peak		
Packets:	196633	2	8097	28567		
Errors:	201	0	6	36		
Alarms:	0	0	0	20		
Delta_Time:		28	20	20		

This *Remote LANView-PC* screen shows statistics for a specific port on a Cabletron Multi Media Access Center (MMAC) in a tabular rather than graphic format. Statistics and alarms are shown on the same screen.

Unspecified error count

Report of peak errors and alarms

List of monitored boards in hub

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for basic management and control functions in twisted-pair and fiber-optic networks. Its ability to attach a low-cost terminal to a wiring hub and get full network control without dedicating a PC to the task will appeal to many cost-conscious LAN managers.

TokenVIEW-4

Network management and control tools are nice to have in Ethernet networks, but they are almost a necessity for large Token-Ring networks. Ethernet stations are like independent radio transmitters and receivers: if one station fails, it seldom disrupts the entire network. Each active Token-Ring node, however, is a critical part of the network: if one adapter board loses the ability to receive or retransmit tokens, the entire ring fails. Either you walk down the hall to a wiring closet and unplug nodes one by one until the network comes back to life, or you purchase Proteon's *TokenVIEW-4* software, sit back, survey the network on a screen, and take fault-isolation actions with a mouse.

TokenVIEW-4 is a renamed version of the company's original *Advanced Network Manager* software. *Advanced Network Manager* was one of the first media-level management and control systems available for PC-based networks. The current version works with Proteon's ProNET-4 network hardware, which is compatible with IBM's Token-Ring hardware; if you manage a pure Token-Ring installation, this product is a powerful tool. You can use Token-Ring cards from any vendor (including IBM, 3Com, Madge, and Racore) in the network nodes, along with the ProNET-4 wiring hubs, to take full advantage of the management system.

The ProNET-4 p2710 Intelligent Wire Center follows the IBM pattern of providing connections for eight nodes in each hub. Each processor-equipped wire center retails for $995, but it can collect data from and manage other $895 Proteon wire centers that lack full microprocessor augmentation. The *TokenVIEW-4* software package sells for $1,995. A complete network of over 24 nodes has a level price of approximately $200 per node, plus the cost of the adapter card in each node.

TokenVIEW-4 is a great application for an old XT-class machine—it can run on any PC with 160K of RAM, a hard disk, a serial port, and an EGA monitor. You also

NETWORK MANAGEMENT: SUMMARY OF FEATURES
(Products listed in alphabetical order)

	LattisNet Network Management System	Remote LANView-PC	TokenVIEW-4
NETWORK VIEW SHOWS:			
Pictorial diagram of network	●	●	●
Network status, good or bad	●	●	●
Peak load	●	○	●
Average load	●	○	●
Current load	●	○	●
Load information as a graph	●	○	●
WORKSTATION VIEW SHOWS:			
Events for individual nodes	●	●	●
Peak load	●	○	●
Average load	●	○	●
Current load	●	○	●
Load information as a graph	●	○	●
MISCELLANEOUS			
Displays traffic error rates	●	●	●
Sorts by error type	●	○	●
Administrator can limit access to authorized nodes	○	●	○
Preformated reports are available within program	○	○	●

▣ = Editor's Choice ● = Yes ○ = No

In a Token-Ring network, if one adapter fails, either you go to the wiring closet and unplug nodes one by one to find it or you buy *TokenVIEW-4*. The product can outfit a 24-node network—even one equipped with XTs—for about $200 per node.

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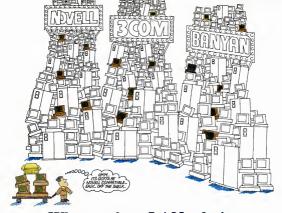
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Proteon's *TokenVIEW-4* software presents information in tabular format describing the activity of the Intelligent Wire Centers and their attached nodes.

The "mini event log" at the bottom of the screen keeps the network manager informed of selected network events.

Because the token-passing activities in Token-Ring adapters are more complex than cable-sharing actions in Ethernet networks, Token-Ring adapters for PCs must have more on-board processing power than typical Ethernet adapters. They also pass along more information about the node's activities, as well as details such as the identity of the next node in the ring. This information becomes a valuable troubleshooting tool if the network dies, as *TokenVIEW-4* collects much of the data reported by the Token-Ring adapters and displays it on request.

SECURE AND ALERT

Proteon's software has better network security features than Synoptics' *LNMS*. *TokenVIEW-4* allows you to prohibit unknown nodes from entering the network. While it doesn't stop a technically sophisticated person from tapping the network to copy data flowing through it, it does prevent someone using a protocol analyzer from attaching to an open port and capturing passwords and data.

You can configure *TokenVIEW-4* to alert you, through the screen display, to a wide variety of events on the network. Proteon lists nine major categories of events, and each major category selection leads to other decisions about the levels or types of events to report. You can set alerts for token errors on the ring, the activity levels of certain nodes, and many other parameters. When the software detects an event you selected, it posts a notice on the screen and to an ASCII log file.

need a Proteon ProNET-4 LAN adapter card in the PC; the card needs a special PROM (programmable ROM, included in the *TokenVIEW-4* package) to address the software.

If you run the ProNET-4 boards with standard IRQ and memory address settings, the task of installing the software consists of copying the files into the correct subdirectory. If you change the addressing of the ProNET-4 boards, then you will have to go through some menus to reconfigure *TokenVIEW-4*.

The computer running the network management and control software connects to the Intelligent Wire Centers through a separate twisted-pair cable. The twisted-pair wire runs in a daisy-chain to each Intelligent Wire Center and provides the communications path between the processors in the intelligent hubs. This net-

work for the hubs gives the software a path to control the wire centers even if the Token-Ring network fails.

WHAT YOU SEE

The *TokenVIEW-4* screen displays aren't as striking as the ones created in Synoptics' *LNMS*, but they provide a good graphical picture of the wire centers and attached devices. The interface uses monochrome screens with pull-down windows and works well with a mouse or other pointing device.

You have to do a lot of database entry to set up the Proteon software, but it is automated enough to recognize new nodes and help with updates. *TokenVIEW-4* can also update itself with information about new Intelligent Wire Centers attached to the twisted-pair wire bus—just go to the menu and select Look for New Wire Centers.

CONNECTIVITY
NETWORK MANAGEMENT

EDITOR'S CHOICE

- LattisNet Network Management System
- TokenVIEW-4

We have made two recommendations in this area because of the differences between systems that work on Token-Ring networks and those that work on Ethernet-based networks.

If you are installing a Token-Ring system, we strongly recommend installing Proteon's ProNET-4 and TokenVIEW-4 systems. It is likely that when Synoptics Communications integrates Token-Ring technology into its LattisNet system, Synoptics will give Proteon strong competition, but for now Proteon is the best.

In the overall area of management and control software, Synoptics' LattisNet Network Management System is certainly the leader. Its sound methods of analysis, impressive interfaces, and comprehensive approach to network analysis make it an easy choice.
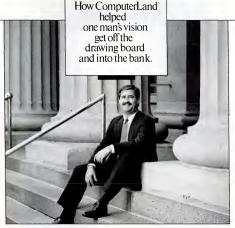
The software gives you the tools to print out several instant status reports, but it doesn't provide capabilities to create reports from sorted log-file data. However, you can import the log-file data into almost any database program and create your own report formats.

Proteon markets OverVIEW, a higher-level software package that accepts information in SNMP format. Marketing literature for OverVIEW also promises eventual CMIP compatibility. Proteon representatives wouldn't say when TokenVIEW-4 would be compatible with OverVIEW, but the need for the connection is obvious. It is possible that, like everyone else, Proteon is waiting for the final CMIP specifications before choosing a development path.

Any network manager planning to install a new Token-Ring network or to expand on an old one will benefit from Proteon's Intelligent Wire Centers and TokenVIEW-4 software. The system can provide faster recoveries and better management of shared resources than any other current Token-Ring alternative. ∎

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine.

How ComputerLand® helped one man's vision get off the drawing board and into the bank.

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CIRCLE 378 ON READER SERVICE CARD

by
Barry Simon

Lab Notes

Providing Program Access to the Real DOS Environment

Most PC users have learned how to use the PROMPT command to remove the humorous greeting the office wag stuck into their DOS environment, and nearly everyone with a hard disk has used the PATH command to tell DOS which subdirectories to search for executable programs and batch files.

Power users who have enough memory to make use of a RAMdisk often copy COMMAND.COM to it as part of their AUTOEXEC.BAT boot-up procedure, and use

```
SET COMSPEC=d:\COMMAND.COM
```

to speed the processes of "shelling out" to DOS from application programs and reloading the transient portion of COMMAND.COM when needed. As discussed in Richard Hale Shaw's two-part PC Lab Notes of March 31 and April 14, 1987, you can also use the SET command to insert strings into the environment from a batch file or from the DOS command line, so programs can access these user-defined strings.

Programmers, however, want to do more than simply customize the initial DOS environment variables. They'd like to give their programs control over the environment, letting them modify items such as the system path and prompt. Unfortunately, programs do not have such access to the active environment. But where there's a will there's a way, and the aim of this Lab Notes is to show you how to do it. Let's start by examining the relation between three distinct DOS "environments."

THE THREE ENVIRONMENTS

DOS keeps a block in memory, the Master Environment Block, in which it stores the current path, prompt, comspec, and so forth. This memory area is also affected by SET commands issued from the DOS prompt or through batch files. I will call this the *real* or *active* environment. If you follow the rules, this area is not accessible

> ■ If you follow the rules, the programs you write can change only a transient copy of the environment. Here's a programmers' guide to environmental outlawry.

to executing programs.

Before a program loads, COMMAND .COM passes a copy of the active environment to it. I will call this copy the *program environment*. A program is given the address of this second environment block in a word at offset 2C of the program's PSP (program segment prefix). Legally, the program can access only this copy of the real environment. Any changes a program makes in its program environment block are transitory, however; when the program exits, that block is freed up.

The third environment, which I'll call the *root environment*, is the environment of the *initial* DOS shell that is set up when the system boots. For most people, the root environment is and remains identical to the active environment. But if you shell out of a program or run *DESQview* or *Carousel*, or if you explicitly run a shell of COMMAND.COM, then the root environment will be different from the active environment.

The distinction is important because it is the active environment, rather than the root, that gets passed (as a copy) to a program and is also used by DOS for the

prompt and path. It is the active rather than the root environment that you want your programs to be able to find and access.

One traditional "folk method" of locating the environment uses the fact that certain interrupts point to the sector containing COMMAND.COM. By examining these interrupts you can find the environment. Unfortunately, however, even if you ignore the possibility that some other program might have stolen the interrupt, this method locates the *root* COMMAND.COM and hence the root environment rather than the active environment that is your goal.

To illustrate the method I use instead, I've written a Turbo Pascal program, FINDENV.PAS, which is listed in Figure 1. This program locates the active environment and computes both the amount of space being used and the amount of space that is still available in the block. The code shown here is from a shareware program called BATUTIL, which will be released shortly by my firm, CTRLALT Associates.This program makes extensive use of the real environment to store information. Although its output is admittedly not very visually stimulating, the information supplied by FINDENV.PAS will be of interest to the many DOS programmers.

One interesting thing that you can do, once you've gained access to the real environment, is to create longer paths. The only reason for the current 128-character limit (actually 123 since PATH= takes up 5 of the 128 characters) is that it's the maximum number of characters DOS allows

Lab Notes

on its command line. If you get a longer path into the environment, DOS doesn't mind at all! As a test of this, I've been running with a path of 232 characters for a number of months, and DOS has had no problem with it. Over the course of running dozens of programs, I've seen only

two that were troubled by it: Flambeaux Software's *Techhelp* and an old obsolete version of Phil Katz's *PKXARC*.

DOS VERSION VARIATIONS

With the introduction of DOS 3.1, it became possible to control the size of the root environment from a CONFIG.SYS command. Previous versions of DOS set a default environment size of 160 bytes. To set the size of the root environment under

DOS 3.1 and later, you use an argument such as

```
shell=C:\command.com /E:xxx /P
```

where *xxx* is a decimal number that represents the number of 16-byte paragraphs to be assigned to the environment (that is, the size of the environment is 16 times the number *xxx*).

With DOS 3.2 and later, *xxx* represents the actual number of bytes you want for the root environment.

You'd think that when a program or user creates a secondary shell for DOS, DOS would make sure that the environment used by the shell was at least as large as the one you asked for in the root. Unfortunately, DOS is not quite so well constructed. Instead, by default, it looks at how much of the environment is actually in use and rounds this up to a multiple of 16 bytes. With DOS 3.2 and later, you can set a shell with the command

```
command /e:xxx
```

and adjust the size of the environment. Alas, most application programs that make a shell for the operating system do not use this feature, so the active environment in the shell is very small.

If an inherited environment turns out to be too small, there is a kludge you can use to get around the problem. Before loading the program from which you want to shell, issue several commands of the form

```
set a=aaaaaaaaaaaaaaaaaaaaaaaaa
set b=aaaaaaaaaaaaaaaaaaaaaaaaa
```

Then, in the shell use

```
set a=
set b=
```

The space created by the bytes taken up by the initial SET commands will still be available after you remove the *a* and *b* variables, so you will end up with more usable space in the active environment than you otherwise would have.

LOCATING THE ACTIVE ENVIRONMENT

Two steps are necessary to locate the active environment. First, you must find the *active* copy of COMMAND.COM. Then you use it to find the active environment. The procedures for finding both COMMAND.COM and its environment are not officially documented. This means, of
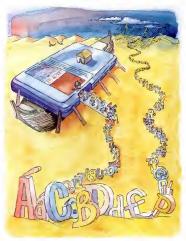
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CIRCLE 241 ON READER SERVICE CARD

Lab Notes

course, that there is a risk that they will not work when a new version of DOS is released. Indeed, the structure changed from DOS 3.1 to 3.2 and again from 3.2 to 3.3. Since you cannot assume that things will remain unchanged, the programs you write will obviously need to check for this. As always, there are potential dangers in using undocumented properties of the operating system.

Remember that the environment is really a memory block. Memory is broken into groups of paragraphs (a paragraph is 16 bytes), which are aligned at paragraph boundaries. These groups are called memory blocks. Each memory block contains a 16-byte header called the memory control block (MCB) for that particular block. Only the first 5 bytes out of 16 are used, of which the first 4 have an ID of the letter M. Z is used for the 5th byte. (The M and Z are the initials of Mark Zbikowski, one of the authors of DOS 2.0.) These two bytes are critical. If you use DEBUG to change the M in the MCB of one of your TSRs (an m, for example) and try to run a program,


```
(*** FINDENV.PAS — A Program to Find the Reel DOS Environment ***)

USES DOS;

VAR
   envseg : Word;                    (address of environment)
   envsize : Word;                   (absolute size of environment)
   envinuse : Word;                  (bytes in env up to first double ##)

FUNCTION SpecialDOS : Boolean;       (true if DOS 3.X)
VAR
   regs : registers;
BEGIN
   WITH regs DO BEGIN
      AH := $30;                      (get MS-DOS version number)
      MsDos(regs);
      IF ((AL = 3) AND (AH > 19) AND (AH < 3Ø)) THEN SpecialDOS := True
      ELSE SpecialDOS := False;
   END;
END;

FUNCTION getDOSPSP : Word;
VAR
   tent, tent1 : Word;
BEGIN
   tent := MemW[PrefixSeg:$16];
   WHILE True DO BEGIN
      tent1 := MemW[tent:$16];
      IF ((tent1 = Ø) OR (tent1 = tent)) THEN BEGIN
         (this means we have DOS!)
         getDOSPSP := tent;
         Exit;
      END ELSE tent := tent1;
   END;
END;

PROCEDURE ComputeEnvInUse;
VAR
   j : Word;
BEGIN
   FOR j := Ø TO (envsize-3) DO
      IF MemW[envseg:j] = $Ø THEN BEGIN (word Ø means two bytes)
         envinuse := j+2;
         Exit;
      END;
   envinuse := envsize;
END;

PROCEDURE getenv;
VAR
   DOSPSP, temp : Word;
BEGIN
   DOSPSP := getDOSPSP;
   temp := MemW[DOSPSP:$2C];
   IF ((temp <> Ø) AND (NOT SpecialDOS)) THEN envseg := temp
   ELSE envseg := DOSPSP+MemW[DOSPSP-1:3]+1;
   envsize := 16*MemW[envseg-1:3];
   ComputeEnvInUse;
END;
```

Figure 1: The source code listing for FINDENV.PAS, a program that locates the real DOS environment and reports its size and the current amount used.

Lab Notes

```
FUNCTION HexDigit(b : Byte) : Char;
BEGIN
   IF b < 10 THEN HexDigit := Char(Ord('0')+b)
   ELSE HexDigit := Char(Ord('A')-10+b);
END;

FUNCTION HexWord(w : Word) : STRING;
BEGIN
   HexWord := HexDigit(w DIV $1000)+HexDigit((w MOD $1000) DIV $100)
   +HexDigit((w MOD $100) DIV $10)+HexDigit(w MOD $10);
END;

BEGIN
   getenv;
   WriteLn('ENVREP. Copyright Ziff Communications Co., 1989');
   WriteLn('  Your active environment is at '+HexWord(envseg)+'H.');
   WriteLn('  The size of the environment is ', envsize, ' bytes');
   WriteLn('  of which ', envinuse, ' bytes are used');
   WriteLn('    leaving ', envsize-envinuse, ' bytes free.');
   WriteLn('  Have a good day.');
END.
```

DOS will decide your memory is corrupted and halt the system.

The 2nd and 3rd bytes of the MCB contain the segment of the owner of the memory block, that is, the PSP of the program that requested the block. It is stored in the usual way words are stored in Intel architecture: the segment 3GA4 would be stored as A4 in byte 2 and 3G in byte 3. (If your compiler understands words, it will normally do the translation for you automatically.) If a program deallocates memory located in the middle of the MCB chain, DOS changes bytes 2 and 3 in the MCB to zeros and will reuse that area for small things like the inherited environment of a program.

Bytes 4 and 5 of the MCB contain the number of 16-byte paragraphs in the memory block. Neither the MCB of that block nor the next one are included in the count, so the address of the next MCB is yyyy:0, where yyyy is the sum of the segment of the current MCB, the word at offset 5 of the MCB plus 1. DOS uses this method to trace through the chain of MCBs. It uses the undocumented DOS service 52h to find the first MCB. You call interrupt 21 with AH=52; on return, ES:(BX-2) forms a pointer to the first MCB.

HOW FINDENV WORKS

To find the active DOS environment, I use the fact that offset 16h of the PSP points to the parent of the current process, with the pointer being to *itself* if the parent program is COMMAND.COM. In essence, the procedure GetDOSPSP in the source code of FINDENV.PAS locates the active COMMAND.COM by chasing the pointer back until it points to itself.

The source code supplied here is meant for illustrative purposes and so ignores even the basics of defensive programming—a foolhardy omission for a real program. For production code, it would be a good idea to keep count of how many pointers you are accessing and to exit gracefully after, say, eight levels (I've never seen more than three levels needed). This will protect against someone adjusting the pointers into a loop! If your program is actually writing to the environment, defensive programming also requires that you compare what you think is the active environment and the program environment passed to you. They should have identical strings. If they don't, exit immediately: writing to the wrong place in memory can and will lead to dire consequences.

Having found the PSP of the active DOS, the FINDENV program can then locate the active environment, but the algorithm for doing so is DOS-version-dependent! Part of the information involves offset 2C in the PSP of the active DOS. If the active DOS is the root, the word at 2C is 0 and the active environment is the memory block after DOS.

But if the active DOS is not the root shell, then the situation is a little more complex. Keep in mind that COMMAND .COM is just a program, so that a DOS shell will have its own program environment placed by the loader of that copy of COMMAND.COM. For DOS 3.1 and earlier, this program environment is also used by the shell as the active DOS environment. For versions 3.2 and later, the shell instead places a memory block immediately following itself and does *not* use the program environment.

For DOS versions 3.2 and earlier, offset 2C points to the *program* environment. For versions 3.3 and later, offset 2C points to the *active* environment. Notice that while the placing of the active environment was changed with version 3.2, the address in 2C changed only in version 3.3. This is the reason behind the strange algorithm embodied in the sample source code: the block of the active environment is the next block in memory if offset 2C=0 or if the DOS version is 3.2; otherwise, the active environment is pointed to by 2C. The block of the active environment is found in the procedure Getenv.

Once the environment has been located, FINDENV uses the environment's structure to determine how much of it is being used. The strings are stored with a single ASCII zero terminating each string and with a double ASCII zero at the end of all strings. Thus a scan for a double 0 locates the end of the used part of the envi-

> Having found the PSP of the active DOS, FINDENV can then locate the active environment.

ronment. An MCB calculation then finds the total length of the block and subtraction gives the amount free.

Admittedly, the DOS world is like the Wild West: there are lots of outlaws around. Indeed, though our purpose is benign, our own attempt to extend program control over the active environment is in and of itself outlaw behavior. But despite this fact—perhaps even because it is *verboten*—it's a challenge that I'm sure many of my fellow programmers will want to take up. ∎

Barry Simon is a professor of mathematics and theoretical physics at Caltech and vice president of the American Mathematical Society.

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by
Michael J. Mefford

Utilities

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Why do the obvious thing and get a copy of *Lotus Express* so that you can send binary files over MCI? Many people I know swear by it—but just as many swear *at* it and can't get it off their machines fast enough. It's a matter of personal style.

The practical problem with using *Express* is that both sender *and* receiver must use this program. *Lotus Express* employs MCI's proprietary Mail Link protocol for uploading and downloading binary files. Therefore, you must use *Express* to download a binary file uploaded with *Express*. Moreover, the specialized Mail Link protocol built into *Express* will work with MCI only, and not with any other e-mail service.

DEBUGSCR.COM, on the other hand, works with all e-mail services—including MCI. It also allows direct user-to-user transfers, if you wish. DEBUGSCR works by converting a binary file into an ordinary ASCII text file you can send without any transfer protocol. Its real beauty, however, is that it does not require the recipient to have a copy of DEBUGSCR to reconvert the text file to binary. All he needs is the ordinary DEBUG.COM that comes with DOS. (Be careful not to confuse the similar names used in this article: DEBUGSCR refers to the *PC Magazine* utility presented here; DEBUG refers to the DOS utility.)

The easiest way to get a copy of DEBUGSCR.COM is to download it from PC MagNet, as explained in the sidebar "DE-

BUGSCR by Modem." The assembly language source code, DEBUGSCR.ASM, is printed here and available from PC MagNet. If you prefer not to work with an assembler, DEBUGSCR.BAS, also listed here and on PC MagNet, will automatically create DEBUGSCR.COM when you run it once in BASIC.

USING DEBUGSCR

DEBUGSCR converts any PC file (up to 60K in length) into an ASCII text script file. The script file contains instructions that tell DEBUG how to re-create the original file. DEBUGSCR can even create a script file from text files, though it was designed to convert binary files, such as .EXEs, .COMs, or *Lotus 1-2-3* worksheets. (In point of fact, I first created DEBUGSCR so I could send copies of my programs to *PC Magazine*'s editors. It's worked so well we thought you might like it, too.) The script files created by DEBUGSCR can be easily transferred electronically as ordinary text files over MCI, CompuServe, or similar data services.

The syntax for DEBUGSCR.COM is

DEBUGSCR filespec [/N]

where *filespec* is the path and name of the

(usually binary) file from which DEBUGSCR will create the script file. The script file will be put in the same directory and have the same filename, except that it will have an .SCR extension. Let's suppose that you have *PC Magazine*'s utility TOGGLE.COM, which reports—and lets you change—the state of your CapsLock, NumLock, and ScrollLock keys, stored in your PCMAG directory on drive C:. Entering

DEBUGSCR C:\PCMAG\NUMLOCK.COM

will create a script file called TOGGLE.SCR in the PCMAG directory. The created script file is shown in Figure 1 and is ready for immediate uploading. At the end of the script file there are instructions for the recipient on how to re-create the binary file.

If you wish, you can add to these instructions by editing the script file with your favorite word processor. You might, for example, want to add an explanation of how to use the utility if the binary file you are sending is a program. Just be *sure*, however, to save the edited script in ASCII text format.

If you regularly send to someone who knows how to re-create your binary files, on the other hand, you will probably want to suppress DEBUGSCR's message. The optional /N switch shown in the DEBUGSCR syntax line above allows you to do this.

You'll find that DEBUGSCR script files are approximately 3.75 times as large as their binary originals. This is not a seri-

Utilities

```
TOGGLE.SCR                                            COMPLETE LISTING

N TOGGLE.COM
E 0100 B9 9C 04 34 4F 47 47 4C 45 2E 53 20 20 63
E 0110 29 2F 31 39 30 38 20 5A 69 46 66 20 43 6F 6D 60
E 0120 75 6E 69 63 61 74 69 6F 6E 73 20 43 6F 6D 60
E 0130 56 41 20 60 61 67 61 7A 69 6E 65 20 74 20 4D 61
E 0140 66 6C 20 20 50 72 6F 73 69 73 65 20 44 1A 60 8A
E 0150 55 73 61 67 65 3A 20 28 28 47 47 4C 45 2E 53 20
E 0160 2A 63 7C 20 6F 73 6C 63 20 20 7C 20 63 6E 20 6A
E 0170 21 73 79 20 20 20 73 20 60 61 20 60 20 0A 29 A0
E 0180 74 78 20 6C 61 65 66 20 20 73 20 0A 20 20 20 A0
E 0190 20 20 20 60 20 20 60 20 63 20 20 2F 20 20 2F 20
E 01A0 20 20 20 20 20 20 20 20 20 20 53 60 6E 0A A0
E 01B0 20 20 24 24 65 6F 61 84 24 49 66 20 0A 20 50
E 01C0 60 20 60 60 20 60 73 20 6F 20 60 20 20 7E 01 02
E 01D0 30 3C 2A 48 74 06 84 40 3C 43 75 20 0F 01 CD 21
E 01E0 80 01 4C 2D 21 AC 20 44 63 3C 3A 74 06 8A 0E 62
E 01F0 3C 43 74 06 84 40 3C 43 75 20 0F 01 CD 21 07 01
E 0200 26 80 28 17 80 EB C1 F8 26 20 7E 61 38 98 10
E 0210 B4 09 BA 53 7F CD 21 B8 08 4C CD 21 CD 21 C0 C1
E 0220 40 1D 60 84 99 BA 0E 01 CD 21 B4 20 80 04 01 84
E 0230 69 84 A1 91 CD 21 84 10 80 85 F0 84 89 CD 21
E 0260 AA D9 01 26 84 26 17 00 74 03 BA 04 01 84 89 CD

RCX
0152
N
Q
```

```
If you have downloaded this script file, remove
any captured communications header and then enter

DEBUG < filename

where filename is the name of this script file.
```

Figure 1: This sample script file for *PC Magazine's* short TOGGLE.COM utility was created by the DEBUGSCR program. DEBUGSCR automatically includes instructions for re-creating the binary file at the end of the script that it has created.

ous problem for short binary file transfers—for example, files of perhaps 20K or less. For larger files, you should use the *PC Magazine* utility 1STCLASS or *Lotus Express*. Indeed, you'll probably not be tempted to exceed DEBUGSCR's 60K input file limitation, for the script file output would be more than 240,000 bytes. And in that case, Federal Express is probably cheaper.

DEBUGSCR script files don't do checksums or include any other error-checking as do *Lotus Express* or Xmodem. It's really not necessary, however. When sending a script file, you can see if noise on the line is spoiling the transfer simply by monitoring the upload. If it doesn't go smoothly, the columns of the script will become irregular.

At the receiving end, before re-creating the original binary file, the script file recipient must edit out any captured communications header, such as the TO: header that prefaces MCI downloads. Any messages that appear at the end of the captured script can remain, however. When the script is processed by DEBUG, DEBUG returns to the DOS prompt when it sees the last instruction, Q for Quit. It never sees any remaining notes.
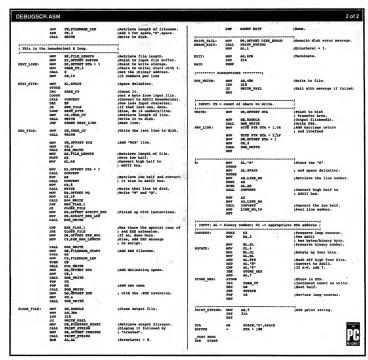
After removing the communications header (and saving in ASCII), the recipient then re-creates the original binary file simply by redirecting the script file to DE-

Figure 2: Converting the 4 bytes of this .EXE binary file example into ASCII hex is a two-step process. The value for 0 (30h) is added to each byte's nibbles and the results are placed in separate bytes. If the result is greater than 39h, an additional 7 is added to produce the hex numbers from A through F.

Utilities

```
; DebugScr converts any disk file into a hexadecimal ASCII script text file.
; Unlike binary files like .EXEs, .COMs or 123 data files, the script file can
; then be sent via a data service like MCI or CIS as an ordinary text file.
; The recipient recreates the original binary file by redirecting the script
; file as Debug's input thus:
;
;           DEBUG < filename.SCR
;
; where filename.SCR is the name of script file created by DEBUGSCR.COM.

_TEXT        SEGMENT PUBLIC 'CODE'
             ASSUME CS:_TEXT,DS:_TEXT,ES:_TEXT,SS:_TEXT
             ORG    100H
START:       JMP    MAIN

             DATA AREA
             ---------
SIGNATURE    DB     CR,BFACE,SFACE,BFACE,CR,LF
COPYRIGHT    DB     "DEBUGSCR 1.0 (C) 1989 Ziff Communications Co. ",CR,LF
PROGRAMMER   DB     "PC Magazine ",BOX," Michael J. Mefford",CR,LF,LF

             DB     "Syntax:  DEBUGSCR filespec [/N]",CR,LF,LF
             DB     "/N = No instruction messages in script",CR,LF,LF
             DB     "filename.SCR will be created",CR,LF
             DB     "To recreate then, Enter",CR,LF,LF

             DB     TAB, "DEBUG < filename.SCR",CR,LF,LF,"$",CTRL_Z

TAB          EQU    9
CR           EQU    13
LF           EQU    10
CTRL_Z       EQU    26
BFACE        EQU    32
BOX          EQU    254

FILESPEC_START DW   ?
FILESPEC_END   DW   ?
FILENAME_START DW   ?
FILENAME_LEN   DW   ?
DOT_ADDRESS    DW   ?

EXE_FLAG     DB     0                    ;Set if and EXE
                                         ; extension found.
MSG_FLAG     DB     0                    ;Set if no suppress script msg.
FILE_LENGTH  DW     ?
HANDLE       DW     ?
LINE_NO      DW     100H
CHAR_CT      DW     ?

FILE         DB     "File"
NOT_FOUND    DB     " not found",CR,LF,LF,"$"
DISK_ERROR   DB     "Disk error",CR,LF,LF,"$"
DOT_SCR      DB     ".SCR",0,"$"
EXE          DB     ".EXE",0,LF
TOO_BIG      DB     "Input file too big; can't be more than 68K",CR,LF,LF,"$"
NOT_ENOUGH   DB     "Not enough memory; requires 64K",CR,LF,LF,"$"
CREATED      DB     "created",CR,LF,LF,"$"
RCX          DB     " RCX",CR,LF
WQ           DB     " Q",CR,LF,LF,CR

SCRIPT_END DB  TAB, "if you have downloaded this script file, remove",CR,LF
           DB  TAB, "any script communications header and then enter",CR,LF
           DB  TAB,TAB,TAB,"DEBUG < fileame",CR,LF,CR,LF
           DB  TAB,"where fileame is the name of this script file.",CR,LF
SCRIPT_END_LEN EQU $ - SCRIPT_END

EXE_MSG  DB  CR,LF
         DB  TAB,"Note this is an EXE script. Debug will not create",CR,LF
         DB  TAB,"a file with an EXE name extension.  You have to add",CR,LF
         DB  TAB,"the EXE extension yourself AFTER the file is created",CR,LF
         DB  TAB,"by Debug by entering the following at the DOS prompt",CR,LF
         DB  CR,LF

         DB  TAB,"RENAME "
EXE_MSG_LENGTH EQU  $ = EXE_MSG

;        CODE AREA
;        ---------
MAIN    PROC   NEAR
        CLD
        MOV    DX,OFFSET SIGNATURE       ;Display copyright and syntax.
        CALL   PRINT_STRING

        MOV    BX,64 / 16 * 1024         ;Minimum 64K memory required.
        MOV    AH,4AH
        INT    21H
        MOV    DX,OFFSET NOT_ENOUGH
        JNC    CAPITALIZE
        JMP    ERROR_EXIT

CAPITALIZE:  MOV    SI,81H               ;Capitalize the command line.
NEXT_CAP:    LODSB
        CMP    AL,CR
        JZ     PARSE
        CMP    AL,"/"
        JNE    CX_CAP
        MOV    BYTE PTR [SI - 1],CR
        LODSB
        CMP    AL,"N"
        JNE    PARSE
        MOV    MSG_FLAG,1
        JMP    SHORT PARSE

CX_CAP:      CMP    AL,"a"
        JB     NEXT_CAP
        CMP    AL,"z"
        JA     NEXT_CAP
        AND    BYTE PTR [SI - 1],5FH
        JMP    NEXT_CAP

PARSE:       MOV    SI,81H               ;Parse the command line.
FIND_START:  LODSB                       ;Find first non-white space.
        CMP    AL,CR
        JNE    CX_SPACE
        MOV    DX,OFFSET FILE            ;If no parameter, display
        JMP    ERROR_EXIT                ; error message.
CX_SPACE:    CMP    AL,SPACE
        JBE    FIND_START

        DEC    SI                        ;Adjust.
        MOV    BP,SI                     ;BP = Filespec start.
        MOV    FILESPEC_START,BP         ;Save it.
        MOV    DX,SI                     ;DX = Filename start.
        XOR    CX,CX                     ;CX = Dot flag.
FIND_END:    LODSB
        CMP    AL,":"                    ;If colon or backslash found,
        JZ     FOUND_PATH                ; it's a path specifier.
        CMP    AL,"\"
        JNE    CK_DOT
FOUND_PATH:  MOV    DX,SI                ;Filename start.
CK_DOT:      CMP    AL,"."                ;If dot, extension follows.
        JNE    CX_END
        MOV    CX,SI
CK_END:      CMP    AL,SPACE             ;Carriage return marks end of
        JA     FIND_END                  ; command line.
        DEC    SI                        ;Adjust.
        MOV    BYTE PTR [SI],0           ;ASCIIZ the filespec.
        MOV    FILESPEC_END,SI           ;Save filespec end.
        MOV    FILENAME_START,DX         ;Save filename start.
        MOV    DOT_ADDRESS,CX            ;Save address of extension.

        MOV    DX,BP                     ;Retrieve filespec start.
        INT    21H                       ;Open file for reading.
        JNC    OPENED
        MOV    BYTE PTR [SI],"$"         ;If failed, display message.
        MOV    FILESPEC_END,SI
        CALL   PRINT_STRING
        JMP    ERROR_EXIT
OPENED:      MOV    BX,AX                ;Else, BX = filehandle.
        MOV    CX,OFFSET BUFFER          ;Point to input buffer.
        MOV    CX,(68 * 1024) + 1        ;Read 68K + 1.
        MOV    AH,3FH
        INT    21H
        MOV    DX,OFFSET DISK_ERROR      ;If failed, disk error.
        JNC    CK_SIZE
        JMP    ERROR_EXIT
CK_SIZE:     CMP    AX,CX                ;Did we read 68K + 1.
        JBE    SAVE_SIZE                 ;If yes, too big.
        MOV    DX,OFFSET TOO_BIG
        JMP    ERROR_EXIT
SAVE_SIZE:   MOV    FILE_LENGTH,AX       ;Else, save file size.
        MOV    AH,3EH                    ;Close input file.
        INT    21H

        MOV    BX,FILESPEC_END           ;Retrieve filespec end.
        MOV    BP,DOT_ADDRESS            ;Retrieve extension address.
        OR     BP,BP                     ;Is there an extension?
        JNZ    CK_EXE                    ;If yes, see if it's an EXE.
        MOV    BP,BX                     ;Else, filename end=
        JMP    SHORT STORE_NAME          ; filespec end.

CK_EXE:      MOV    SI,BP                ;Point to extension address.
        MOV    DI,OFFSET EXE
        MOV    CX,4
        REPZ   CMPSB
        JNE    STORE_NAME                ;If the extension is EXE then
        MOV    EXE_FLAG,1                ; special case.
        MOV    BX,BP                     ;filespec end=
                                         ; extension address.
STORE_NAME:  MOV    SI,FILENAME_START    ;Filename.
        MOV    CX,BX                     ;Calculate filename length.
        SUB    CX,SI
        MOV    FILENAME_LEN,CX           ;Save length.
        MOV    DI,OFFSET LINE * 3        ;Place name in DTA.
        REP    MOVSB

MAKE_SCRIPT: MOV    SI,OFFSET DOT_SCR    ;Convert filespec to script
        MOV    DI,BP                     ; name by adding .SCR
                                         ; extension.
        MOV    CX,6
        REP    MOVSB

        MOV    DX,FILESPEC_START         ;Create a normal file with the
        XOR    AL,AL                     ; .SCR extension so it's its name.
        MOV    AH,3CH
        INT    21H
        MOV    DX,OFFSET DISK_ERROR      ;If failed, disk error.
        JNC    SAVE_HANDLE
        JMP    ERROR_EXIT
SAVE_HANDLE: MOV    HANDLE,AX            ;Else, save file handle.
```

DEBUGSCR.ASM: The assembly language source code for DEBUGSCR.COM, which turns binary files into an ASCII form that can be transmitted over MCI and subsequently reconverted to its original form using DOS's DEBUG.

```
        MOV     CX,FILENAME_LEN     ;Retrieve length of filename.
        ADD     CX,3                ;Add 3 for space,"R",space.
        CALL    WRITE               ;Write to disk.
;-----------------------------------;
; This is the hexadecimal E loop.   ;
;-----------------------------------;
        MOV     BP,FILE_LENGTH      ;Retrieve file length.
        MOV     SI,OFFSET BUFFER    ;Point to input file buffer.
NEXT_LINE:
        MOV     DI,OFFSET DTA + 1   ;Point to write storage.
        MOV     CHAR_CT,3           ;Chars to write; start with 3.
        CALL    E                   ;Get the (8)ntar address.
        MOV     CX,16               ;16 numbers per line
NEXT_BYTE:
        MOV     AL,SPACE            ;Space delimiter.
        STOSB
        INC     CHAR_CT             ;Count it.
        LODSB                       ;Get a byte from input file.
        DEC     BP                  ;One less input character.
        JZ      END_FILE            ;If that last one, done.
        LOOP    NEXT_BYTE           ;Else, do 16 numbers/line.
        CALL    WRITE               ;Retrieve length of line.
        MOV     DX,OFFSET DTA + 1   ;Write it to disk.
        JMP     SHORT NEXT_LINE     ;Next line.
END_FILE:
        MOV     CX,CHAR_CT          ;Write the last line to disk.
        CALL    WRITE
        MOV     DX,OFFSET RCE       ;Add "RCX" line.
        MOV     CX,6
        CALL    WRITE
        MOV     AX,FILE_LENGTH      ;Retrieve length of file.
        PUSH    AX                  ;Save low half.
        MOV     AL,AH               ;Convert high half to
                                    ; ASCII hex.
        MOV     DI,OFFSET DTA + 1
        CALL    CONVERT
        POP     AX                  ;Retrieve low half and convert.
        CALL    CONVERT             ; It else to ASCII hex.
        MOV     CX,5
        CALL    WRITE               ;Write that line to disk.
        MOV     DX,OFFSET WQ        ;Write "W" and "Q".
        MOV     CX,18
        CALL    DOS_WRITE
        CMP     MRG_FLAG,1
        JE      CLOSE_FILE
        MOV     DX,OFFSET SCRIPT_END ;Finish up with instuctions.
        MOV     CX,SCRIPT_END_LEN
        CALL    DOS_WRITE
        CMP     EXE_FLAG,1          ;Was there the special case of
        JNE     CLOSE_FILE          ; and EXE extension.
        MOV     DX,OFFSET EXE_MSG   ;If so, done here.
        MOV     CX,EXE_MSG_LENGTH   ;Else, add EXE message
                                    ; to script.
        CALL    DOS_WRITE
        MOV     DX,FILENAME_START   ;Add REM filename.
        PUSH    DX
        MOV     CX,FILENAME_LEN
        PUSH    CX
        MOV     DX,OFFSET DTA       ;Add delimiting space.
        CALL    DOS_WRITE
        POP     CX
        POP     DX                  ;Add new name
        MOV     DX,OFFSET EXE       ; with the .EXE extension.
        MOV     CX,6
        CALL    DOS_WRITE
CLOSE_FILE:
        MOV     BX,HANDLE           ;Close output file.
        MOV     AH,3Eh
        INT     21h
        JC      WRITE_FAIL
        MOV     DX,FILESPEC_START   ;Retrieve output filespec.
        MOV     DX,OFFSET CREATED   ;Display it followed by
        CALL    PRINT_STRING        ; "created".
        XOR     AL,AL               ;ErrorLevel = 0.

        JMP     SHORT EXIT          ;Done.
;-----------------------------------;
WRITE_FAIL:
        MOV     DX,OFFSET DISK_ERROR ;Generic disk error message.
ERROR_EXIT:
        CALL    PRINT_STRING
        MOV     AL,1                ;ErrorLevel = 1.
EXIT:
        MOV     AH,4CH              ;Terminate.
        INT     21h
MAIN    ENDP
;********* SUBROUTINES *********;
DOS_WRITE:
        MOV     AH,40H              ;Write to file.
        INT     21H
        JC      WRITE_FAIL          ;Exit with message if failed.
        RET
;-----------------------------------;
; INPUT: CX = count of chars to write. ;
;-----------------------------------;
WRITE:
        MOV     DX,OFFSET DTA       ;Point to Disk
                                    ; Transfer Area.
        MOV     BX,HANDLE           ;Output filshandle.
        CALL    DOS_WRITE           ;Write DTA.
NEW_LINE:
        MOV     BYTE PTR DTA + 1,CR ;Add carriage return
        MOV     DX,OFFSET DTA + 1   ; and linefeed
        MOV     CX,2
        CALL    DOS_WRITE
        RET
;-----------------------------------;
E:
        MOV     AL,"E"              ;Store the "E"
        STOSB
        MOV     AL,SPACE            ; and space delimiter.
        STOSB
        MOV     AX,LINE_NO          ;Retrieve the line number.
        XCHG    AL,AH
        CALL    CONVERT             ;Convert high half to
                                    ; ASCII hex.
        POP     AX
        MOV     AX,LINE_NO
        CALL    CONVERT             ;Convert the low half.
        ADD     LINE_NO,16          ;Next line number.
        RET
;-----------------------------------;
; INPUT: AL = binary number; DI -> appropriate DTA address ;
;-----------------------------------;
CONVERT:
        PUSH    CX                  ;Preserve loop counter.
        MOV     DX,2                ;Two ASCII
                                    ; hex bytes/binary byte.
        MOV     BL,AL               ;Preserve binary number.
ROTATE:
        MOV     CL,4
        ROL     BL,CL               ;Rotate by four bits.
        MOV     AL,BL
        AND     AL,0FH              ;Mask off high four bits.
        ADD     AL,"0"              ;Convert to ASCII.
        CMP     AL,"9"              ;If A-F, add 7
        JBE     STORE_HEX
        ADD     AL,7
STORE_HEX:
        STOSB                       ;Store in DTA.
        INC     CHAR_CT             ;Increment count to write.
        DEC     DH                  ;Next half.
        JNE     ROTATE
        POP     CX                  ;Restore loop counter.
        RET
;-----------------------------------;
PRINT_STRING:
        MOV     AH,9                ;DOS print string.
        INT     21h
        RET
;-----------------------------------;
DTA     DB      SPACE,"R",SPACE
BUFFER  =       DTA + 188
;_TEXT ENDS
END     START
```

BUG's input, for example:

```
DEBUG < filename
```

where *filename* is the name of the script file created by DEBUGSCR. Voilà!

EXCEPTIONAL CASES

Users of PC MagNet and the CompuServe Information Service have probably noticed that, unless specifically told otherwise, CIS will try to format uploaded messages in as few lines as possible. Short lines, such as the R, W, and Q commands at the end of the DEBUGSCR script file, normally would be put all on one line. This CIS-imposed formatting can be suppressed, however, by placing a space as the first character on a line. DEBUGSCR, therefore, indents each line of the script with a space, just in case you might want to upload to CIS. The space character is ignored by DEBUG.

Files with an .EXE extension provide one additional complication for DEBUGSCR to overcome. DEBUG won't write an .EXE extension to disk. Without going into details, DEBUG does this to protect you from writing over .EXE header information. If you try to write an .EXE file from DEBUG, you'll get the eloquently laconic message

```
EXE and HEX files cannot be written
```

Fortunately, you can trick DEBUG into

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PC MAGAZINE	# DEBUGSCR COMMAND

Michael J. Mefford | November 28, 1989 (Utilities)

DOS Commands

Purpose: To convert binary files into ordinary ASCII text files, which can be transmitted over MCI Mail and similar services and reconverted to their original binary form using the DOS DEBUG command.

Format:
```
DEBUGSCR filespec [/N]
DEBUG < filename
```

Remarks: Use the first command shown above to create a DEBUGSCR script file from a binary file (.COM, .EXE, .WK1, for example) named in the *filespec*. An alternate drive and path can be specified. The script file is automatically given an .SCR extension and is placed in the same directory as the original file. The script file consists of an ASCII hex representation of the original binary values, together with the commands DEBUG needs to re-create the original file. The script file ends with appropriate instructions to the recipient. These instructions are ignored by DEBUG and can be suppressed altogether by using the optional /N switch.

The .SCR file can be edited with a word processor before transmission to append additional information, such as how to use the utility being sent. The .SCR file must then be resaved in pure ASCII form. Similarly, before reconverting the .SCR file with DEBUG.COM, the recipient must edit out any header prefixed to the file by the communications service (for example, the TO: heading added by MCI). After resaving in ASCII, the recipient simply uses the second command line shown above under FORMAT, supplying the desired final *filename*.

DEBUGSCR.COM can be downloaded from PC MagNet (see the "DEBUGSCR by Modem" sidebar). Also available from PC MagNet and printed in the article are DEBUGSCR.BAS and DEBUGSCR.ASM. DEBUGSCR.BAS will automatically create DEBUGSCR.COM when run once in BASIC. To assemble the program from its source code listing requires the use of a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM DEBUGSCR;
LINK DEBUGSCR;
EXE2BIN DEBUGSCR DEBUGSCR.COM
```

Note: DEBUGSCR will not work with files over 60K.

DEBUG.COM will not write a filename with an .EXE extension to disk. DEBUGSCR therefore strips this extension and appends a warning to the recipient that after using DEBUG he must rename the file to include its proper .EXE extension.

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writing an .EXE file in its entirety simply by renaming the file to omit the forbidden extension. DEBUGSCR uses this trick. If you tell it to create a script file from an .EXE file, DEBUGSCR strips the extension before placing it in the first line of the script. After the original file is re-created by DEBUG, however, the file must be renamed with its original, proper .EXE extension. To make sure this very important renaming step is not overlooked by the script file's recipient, DEBUGSCR puts a very prominent reminder instruction at the end of all .EXE scripts.

BINARY VERSUS TEXT

The difference between a binary file and a text file can be confusing. In its literal sense, *every* file is a binary file, since it is composed entirely of bytes of binary ones and zeros. In more customary usage, *binary* denotes all but strict ASCII text files. These include executable files, such as .EXE and .COM files, and data files, such

as *1-2-3* and *dBASE* files. Binary files may *contain* some ASCII text strings, however, as messages or as a copyright notice.

The values of the bytes in a "text" file are meant to be interpreted using the standard ASCII table familiar to every *PC Magazine* reader. ASCII decimal values between 32 and 127 represent the alphanumeric and punctuation characters of our alphabet. Values below decimal 32 are called *control* characters, which include the carriage return and line-feed characters, which mark the end of a text line. Values in the range from decimal 128 to 255 are know as *high* or *extended* ASCII, and are not strictly standardized. This range is used for the IBM extended character set, which includes a foreign character subset and box drawing characters.

A byte that has a value of binary 01000001 has a value of 41 in hexadecimal notation and 65 in decimal; they are simply three ways of designating the same value. That value is interpreted as the capital letter A by the ASCII interpreter program built into your word processor. The *same* value, 41h, in the code section of .EXE or .COM file, would be interpreted

by the CPU as the instruction INC CX, which tells the processor to increment the CX register. And in a spreadsheet data file, 41h would be interpreted literally, as the numeric value, 41h.

The real difference between a binary and text file, therefore, is how the bytes of a file are interpreted. ASCII text files are always interpreted as characters from the ASCII table. Binary files may be interpreted as some combination of machine codes, binary values, and ASCII text bytes.

Not all text files are ASCII text files, either. For example, a *WordPerfect* text file is actually a binary file. That's because *WordPerfect* (and most other word processors) mix in special codes along with the ASCII text. These special codes are understood only by that particular word processing program. There are codes for italics and boldface, codes for paragraphs, margins, and page lengths, and special bytes that tell the processor where the cursor was when the document was saved. Some of this information is stored in a binary section at the beginning of the document. One word processor usually can not understand the codes of another.

DEBUGSCR.BAS   **COMPLETE LISTING**

```
100 REM - BASIC PROGRAM TO CREATE DEBUGSCR.COM
110 CLS:PRINT "Creating DEBUGSCR.COM": OPEN "DEBUGSCR.COM" AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM=0
130 FOR I = 1 TO    89
140 LINESUM=0: LOCATE 2,31 PRINT "Countdown:    "   89 - I ;
150 FOR J = 1 TO  16: READ BYTES: BYTE = VAL("&H" + BYTES)
160    CHECKSUM = CHECKSUM + BYTE: LINESUM$ = LINESUM$ + BYTE
170    IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180    NEXT J
190    READ LINETOTS: LINECHECK$ = VAL("&H"+LINETOTS)
200    IF LINECHECK$ = LINESUM$ THEN GOTO 220
210    LOCATE 4,2: PRINT "Error in Line #" ;  260 + 10 * I: GOTO 269
220 NEXT I
230 CLOSE: READ FILETOTS : FILECHECK$ = VAL(FILETOTS)
240 IF CHECKSUM$ = FILECHECK$ THEN GOTO 260
259 PRINT: PRINT "DEBUGSCR.COM created successfully" : END
260 PRINT: PRINT "DEBUGSCR.COM is not valid!": END
270 DATA 89, 37,  3, 26, BC, 25, AA, 14, 04, 45, 42, 59, 47, 53, 42, 3A4
290 DATA 52, 20, 31, 2E, 39, 29, 28, 43, 29, 20, 31, 39, 38, 39, 20, 5A, 32A
290 DATA 69, 66, 66, 2E, 43, 6F, 6D, 6D, 79, 6E, 49, 43, 61, 74, 49, 4F, 43D
300 DATA 6E, 73, 2E, 41, 6E, 47, 2E, 20, 0, A, 99, 43, 39, 40, 41, 67, 61, 441
310 DATA 6C, 6C, 20, 72, 69, 67, 68, 74, 73, 20, 72, 65, 73, 65, 72, 76, 411
320 DATA 65, 64, 2E, 20, 24, 44, 42, 55, 47, 53, 43, 52, 2E, 43, 4F, 4D, 491
340 DATA 61, 78, 3A, 20, 2E, 44, 46, 42, 55, 47, 53, 43, 52, 2E, 66, 69, 491
350 DATA 6C, 65, 3A, 20, 3F, 0A, 0D, 62, 79, 20, 29, 33, 39, 39, 2C, 20, 3FC
360 DATA 68, 20, 6D, 69, 73, 73, 2E, 20, 69, 6E, 73, 74, 72, 75, 63, 74, 4F7
370 DATA 69, 6F, 20, 65, 73, 20, 78, 20, 20, 20, 20, 20, 20, 20, 20, 20, 501
```

DEBUGSCR.BAS: As an alternative to using a macro assembler, running this listing in BASIC will automatically create DEBUGSCR.COM.

Utilities

Every word processor, however, knows how to interpret an ASCII file, because ASCII is a globally accepted standard. That's why you are asked to save a document in pure ASCII form when the file is destined for another word processor or any generic use. In the process of saving the document in ASCII, the word processor strips all its special codes.

MCI AND BINARY

MCI assumes everything you send its way is an ASCII-interpreted character. When you upload a file, MCI also ignores all the control characters other than the carriage return, line-feed, and tab characters. If you try to upload a binary file and it has any of the other control characters, they will be stripped out of the transmission. A binary file will almost always have some bytes that look like ASCII control codes, so a binary file upload will be incomplete.

The other part of the story is that e-mail services in general, and MCI in particular, will accept only the first 7 bits of a byte. The 8th bit is always assumed to be zero. A binary file invariably contains bytes that have the 8th bit "set" (that is, equal to one), but this "high bit" is ignored by MCI.

If you've ever tried to send a text file containing box drawing characters from the IBM Extended character set to 7-bit systems like MCI, you've probably noticed that you get M's and (u's and such instead of the desired line characters. This is because the 8th bit is not accepted and the 7 remaining bits are interpreted as a low ASCII character-set value. A high-ASCII vertical line character with a value of 179, for example, is received as a 51—the decimal value for the ASCII numeral 3 character. The reason Lotus Express can send 8-bit binary files is that it shifts MCI into a protocol that handles 8-bit data through proprietary codes.

HOW DEBUGSCR WORKS

DEBUGSCR makes use of DEBUG's command set and of its ability to write binary files to disk. As seen in Figure 1, the first DEBUG command in DEBUGSCR's script file is N for the Name of the file to be written to disk. Following the N command line comes the bulk of the script, which consists of a series of E (Enter) commands. The first number after the E command is the address offset in memory at which to start entering the hexadecimal byte values that are to follow. All numbers in DEBUG are in hexadecimal notation.

Up to 16 values follow the E address argument. Sixteen values per line is convenient when working with an 80-column display. More convenient still, since 16 decimal is 10 in hex, the next E address offset argument will always be an even 10h larger. DEBUG's E command is very similar to BASIC's POKE command. The DEBUGSCR script file uses the E command to place the values of the original binary file sequentially in memory.

Once an exact map of the original binary file has been poked into memory, DEBUG needs to know how many bytes to write to disk. This is done by loading the CX register with the size of the file. The RCX (Register CX) command displays the current value of the CX register, and the following line gives DEBUG the new value. In the example shown in Figure 1, this new value is 0152, because the TOGGLE COM file is 0152h (338 decimal) bytes long. (Programmers will recognize that actually it's the BX:CX pair of registers that tells you the length of the file. DEBUGSCR is limited to files of less than 64K, however, which only require the CX register for this information. DEBUG initializes BX to zero.)

The W command then causes DEBUG to write the memory image to the filename specified by the earlier N command. If W is entered without an argument, the write starts at memory offset 100h. (That's why the first E command is at 100h.) The last command in the script is Quit, which returns control to the DOS prompt. If the file written was an .EXE file, it must now be renamed with the .EXE extension, as explained above. The warning message for this is shown at label EXE.MSG in the source code listing.

The real key to being able to use DE-

Utilities

BUGSCR script files lies in the fact that DEBUG understands the DOS < redirection command. The less-than sign tells DEBUG to get all its subsequent commands from the file named immediately after the <, just as if they had been typed in at the keyboard.

BINARY TO HEX ASCII

Figure 2 shows the steps involved in converting the first 4 bytes of a sample .EXE binary file into a hexadecimal ASCII script file. The binary file bytes have the values 4Dh, 5Ah, 01h, and E1h, which have an IBM-extended ASCII interpretation of M, Z, a happy face control character ( ), and a lowercase Greek beta ( ). Since the first two bytes fall within the standard alphanumeric section of the ASCII table, they could be successfully uploaded to MCI without change. The 01h control character, however, would be lost, and the 8th bit of the E1h byte would not be accepted and would end up as 61h, a lowercase a. That the need for conversion.

The first step in the process is to separate each byte into its hexadecimal halves, which are known as nibbles. Each nibble is placed in the lower half of a byte of its own, with the high nibble of the new byte set to zero. The value of 30h (which is the value for the ASCII character zero) is added to each of these bytes. This converts a hex value into an ASCII character representation. For example, in Figure 2 the original 04h value ends up as 34h, the value for the ASCII numeral 4 character.

This works fine for the values between 0 and 9. Another step must occur to handle hexadecimal values above 9. Hexadecimal notation uses the letters A through F for the decimal values 10 through 15. Since there are seven characters that separate the 9 and the capital A in the ASCII table, to complete the ASCII hex conversion, another 7 must be added to all first-stage conversions that end up above 39h. For example, adding 30h to the 0Dh half of the ASCII M results in 3Dh. Since this is above 39h, an additional 7 is added to its value to get the 44h, an ASCII D.

The ASCII results are the character representations of each nibble of the original binary file. Every resulting value falls between 0 and 9 and A and F, all of which are ASCII text characters that can be sent via MCI. DEBUGSCR then places a space character (ASCII 20h) in the script file in between each pair of ASCII nibbles. Each pair represents a single binary byte. When DEBUG gets the ASCII hex file it simply reverses the process to convert it back to the original binary values.

There are now two reasons for converting into hex ASCII instead of decimal ASCII. The first is that hexadecimal values can always be represented by two ASCII bytes. The largest value a byte can have in hex is FF. That value is 255 in decimal, which requires 3 bytes instead of the 2 hex bytes. Hexadecimal, therefore, makes for smaller script files. (Incidentally, smaller listings are also the reason the BASIC data listings in this column are done in hex.) More importantly, hex is used because that's the number system DEBUG understands.

So now that you understand DEBUGSCR, give it a try the next time you need to send a binary file via e-mail. ■

Michael J. Mefford is a contributing editor of PC Magazine.

by
Charles Petzold

Environments

Beyond the Consistent User Interface of the Presentation Manager

The consistent user interface it provides is a major selling point for a graphical environment such as the OS/2 Presentation Manager. Code to handle the most common items in the user interface (menus, dialog boxes, text entry fields, scroll bars) is built right into the environment, making it available to every application. Thus, even a relatively small PM program can come with all the trappings of a sophisticated user interface.

The consistent user interface is a great advantage for users, as well. The menu system incorporated into most Presentation Manager programs provides a good illustration. The main menu bar always appears near the top of the program's window, right under the title bar. Submenus are often invoked by selecting items on the main menu bar. The use of the keyboard and mouse to choose items on the menu is entirely consistent among applications.

There are published guidelines for structuring the user interface, so programmers can deliberately follow conventions established by existing applications. For example, programs that work with documents must have a menu option to open an existing document file. The conventions establish that the first item on the main menu bar should be "File." Selecting this item invokes a submenu that includes the item "Open." Users can select this option using the mouse or with three keystrokes: Alt, F, and O. That makes it easy for users to move from one PM program to another.

DO WANT THIS?

The whole idea of a consistent user interface scares some people. How can we be sure that the user interface chosen by the developers of the system is the best possible interface?

Well, we can't, of course. Such judgments *are* subjective, and if the best possible interface were obvious to everyone, we wouldn't have thousands of different user interfaces under DOS. What all these inconsistent interfaces really show, however, is that PC users seem able to get accus-

> ■ A programmer's creativity need not fall victim to standardized handling of menus and scroll bars. Here's an enhancement a lot of programmers should consider using.

tomed to almost anything. People often identify the best user interface with the one used by their favorite application. The implication for that style of user interface, but rather because the interface grew on them.

We are entering an era in which the same look and feel will be found in three major environments, under three major operating systems: *Microsoft Windows* under DOS, the Presentation Manager under OS/2, and OSF/Motif under Unix. Users

will be able to move among these three environments without problems.

The PM user interface is also part of the CUA (Common User Access) component of IBM's SAA (Systems Application Architecture). This means that when IBM's minicomputer and mainframe applications begin moving to a graphical interface, they too will look and feel like the OS/2 Presentation Manager, *Windows*, and OSF/Motif. IBM has also defined a character-mode user interface in SAA that works very similarly to the graphical user interface.

Moreover, the general style of this user interface is common on other graphical environments, such as the Macintosh. Someone conversant with *Windows* or PM can sit down at a Mac and begin using it immediately. Even some character-mode programs under DOS have been adopting the SAA-style interface.

The key point here is consistency—even if the user interface of PM were terrible, it would still be useful, because it

```
; ----------------------
; POPMENU Make file
; ----------------------

popmenu.obj : popmenu.c popmenu.h
    cl -c -G2sw -W3 popmenu.c

popmenu.res : popmenu.rc popmenu.h
    rc -r popmenu

popmenu.exe : popmenu.obj popmenu.def
    link popmenu, /align:16, NUL, os2, popmenu
    rc popmenu.res

popmenu.exe : popmenu.res
    rc popmenu.res
```

COMPLETE LISTING

Figure 1: The POPMENU Make file aids in the construction of POPMENU.EXE.

Environments

would at least be consistent with everything else. Further, since the user interface code is built into the operating system, it's even possible for a later version of the operating system to improve it in some way, and (in effect) automatically improve all existing programs that use it.

Another fear that some people have is that a consistent user interface will lead to a bland uniformity among applications. In fact, however, this has certainly not been the case with applications for the Macintosh and Windows. Some of the programs for these environments have been among the most interesting and powerful ever developed. When you get right down to it, the environment implements only the most common and mundane aspects of the user interface. A program's real look, feel, and functionality encompasses much more than menus, dialog boxes, and scroll bars.

Finally, some people see no need for a consistent user interface. After all, it is common knowledge that in many corporations most PC users work with only one or two application programs, such as Lotus 1-2-3 or WordPerfect. I contend, however, that the extreme differences among user interfaces in DOS applications are precisely what prevent people from using other programs and extending the productivity of their PCs.

When users can move from one application to another without completely reorienting their fingers and minds, they will do so—especially when they can use these applications synergistically. The Presentation Manager allows easy switching among applications and permits transferring data between them using the clipboard or DDE (Dynamic Data Exchange).

CREATIVE OPPORTUNITIES

Programmers are by no means locked into the PM look and feel. You might want to write a Presentation Manager program that embodies your own, unique user interface. If you so wish, there's nothing to stop you.

The most extreme approach of this kind would be to create a blank window that occupies the full screen in the Presentation Manager session. The program could draw whatever it wants on that window (including its own menus), and do all its own keyboard and mouse input processing. Indeed, the program could even ignore the mouse entirely and hide the mouse pointer.

I must observe, however, that historically this approach has been disastrous. In the early days of other environments without adapting them to the Macintosh interface. Mac users almost unanimously rejected these applications. I think this indicates that users want a consistent user interface. Even though you are certainly not locked into the Presentation Manager look and feel, you ignore it at your own risk.

MENU EXTENSIONS

Of course, it is also possible to extend the user interface in some way. In one sense almost every application does this because it requires some user input beyond the menu, dialog boxes, and scroll bars. In a broader sense, however, suppose an application were to offer the user an alternative to the standard interface.

I have an example in mind—a new Presentation Manager application I've been looking at recently. I can't discuss the program itself; it's still in development as I write this column (in August). But I can discuss how the program extends its menu interface.

The application in question has a standard menu bar, of course, which works exactly the same as the menus found in other Presentation Manager programs. However, if you press the right mouse button on one of the client windows in this program, a pop-up menu appears at the mouse point-


```
POPMENU.C                                                    1 of 2

/*-----------------------------------------------------------
    POPMENU.C -- Popup Menus for OS/2 Presentation Manager
                 (c) 1989, Ziff Communications Co.
                 PC Magazine • Charles Petzold, August 1989
-----------------------------------------------------------*/

#define INCL_WIN
#include <os2.h>
#include "popmenu.h"

HRESULT EXPENTRY ClientWndProc (HWND, USHORT, MPARAM, MPARAM) ;
HRESULT EXPENTRY AboutDlgProc  (HWND, USHORT, MPARAM, MPARAM) ;

int main (void)
    {
    static CHAR   szClientClass[] = "PopMenu" ;
    static ULONG  flFrameFlags = FCF_TITLEBAR    | FCF_SYSMENU    |
                                 FCF_SIZEBORDER   | FCF_MINMAX     |
                                 FCF_SHELLPOSITION| FCF_TASKLIST   |
                                 FCF_MENU ;

    HAB     hab ;
    HMQ     hmq ;
    HWND    hwndFrame, hwndClient ;
    QMSG    qmsg ;

    hab = WinInitialize (0) ;
    hmq = WinCreateMsgQueue (hab, DEFAULT_QUEUE_SIZE) ;

    WinRegisterClass (hab, szClientClass, ClientWndProc, 0L, 0) ;

    hwndFrame = WinCreateStdWindow (HWND_DESKTOP, WS_VISIBLE,
                                    &flFrameFlags, szClientClass, NULL,
                                    0L, NULL, ID_RESOURCE, &hwndClient) ;

    while (WinGetMsg (hab, &qmsg, NULL, 0, 0))
        WinDispatchMsg (hab, &qmsg) ;

    WinDestroyWindow (hwndFrame) ;
    WinDestroyMsgQueue (hmq) ;
    WinTerminate (hab) ;
    return 0 ;
    }

HRESULT EXPENTRY ClientWndProc (HWND hwnd, USHORT msg,
                                MPARAM mp1, MPARAM mp2)
    {
    static HWND hwndMenuPopup ;
    HPS         hps ;
    POINTL      ptlMouse ;

    switch (msg)
        {
        case WM_CREATE:
            hwndMenuPopup = WinLoadMenu (hwnd, NULL, ID_POPUP) ;
```

Figure 2: The POPMENU.C file contains the source code for the program that extends the standard PM user interface by providing pop-up menus.

It took a certain type of customer to first see the beauty of buying from CompuAdd.

Environments

```
                WinSetWindowPos (hwndMenuPopup, NULL,
                                 0, 0, 0, 0, SWP_SIZE) ;
                WinSetParent (hwndMenuPopup, HWND_DESKTOP, FALSE) ;
                return 0 ;

            case WM_BUTTON2UP:
                WinQueryPointerPos (HWND_DESKTOP, &ptlMouse) ;
                ptlMouse.y -= WinQuerySysValue (HWND_DESKTOP,
                                                SV_CYMENU) ;

                WinSetWindowPos (hwndMenuPopup, NULL,
                                 (SHORT) ptlMouse.x, (SHORT) ptlMouse.y,
                                 0, 0, SWP_MOVE) ;

                WinSendMsg (hwndMenuPopup, MM_SELECTITEM,
                            MPFROM2SHORT (IDM_POPUP, FALSE),
                            MPFROMSHORT (FALSE)) ;

                WinSetCapture (HWND_DESKTOP, hwndMenuPopup) ;
                return 0 ;

            case WM_COMMAND:
                switch (COMMANDMSG(&msg)->cmd)
                    {
                    case IDM_ABOUT:
                        WinDlgBox (HWND_DESKTOP, hwnd, AboutDlgProc,
                                   NULL, IDD_ABOUT, NULL) ;
                        return 0 ;
                    }
                break ;

            case WM_PAINT:
                hps = WinBeginPaint (hwnd, NULL, NULL) ;
                GpiErase (hps) ;
                WinEndPaint (hps) ;
                return 0 ;
            }
        return WinDefWindowProc (hwnd, msg, mp1, mp2) ;
        }

MRESULT EXPENTRY AboutDlgProc (HWND hwnd, USHORT msg,
                               MPARAM mp1, MPARAM mp2)
    {
    switch (msg)
        {
        case WM_COMMAND:
            switch (COMMANDMSG(&msg)->cmd)
                {
                case DID_OK:
                case DID_CANCEL:
                    WinDismissDlg (hwnd, TRUE) ;
                    return 0 ;
                }
            break ;
        }
    return WinDefDlgProc (hwnd, msg, mp1, mp2) ;
    }
```

er position. After you choose an item from that menu, the menu disappears. Although pop-up menus are found on some graphical user interfaces, they are certainly not part of the standard PM interface.

The more I used these pop-up menus, the more I liked them. If I happened to be doing something in the client window with the mouse, it was a lot easier just to press the right mouse button for the menu instead of moving the mouse to the normal menu at the top of the window. Because Presentation Manager applications rarely make use of the right mouse button anyway, giving the button this function makes

a lot of sense.

The program seemed to be using the built-in Presentation Manager menu logic for the pop-up menus. I was intrigued, however, that the application's programmers had found some way to force the menu to appear not at the top of the window, but at a location based specifically on the mouse position.

Naturally, I couldn't resist attempting to reproduce this amazing feat in one of my own programs. The task turned out to be less complex than I had initially feared. In fact, it was remarkably easy, which indicates to me a high degree of generality in

the PM user interface code. The pop-up menus that I developed don't work exactly the same as those in the application I'd been examining, but they are fairly close and certainly usable.

THE POPMENU PROGRAM

Figures 1 through 5 contain all the files needed to create POPMENU, a program that includes both a conventional Presentation Manager menu and a pop-up menu you can invoke by pressing the right mouse button from any point within the client window.

As usual, if you have the Microsoft C Compiler 5.1 and the OS/2 Programmers Toolkit (or Presentation Manager Softset) installed, you can create POPMENU.EXE by running

    MAKE POPMENU

You can download all source code and POPMENU.EXE from PC MagNet. You will, of course, need OS/2 1.1 or later to run POPMENU.EXE.

POPMENU doesn't do much of anything except demonstrate the pop-up menu. The program shows many menu options, but it responds to only one of them—the "About PopMenu" option, which displays a dialog box.

The screen shot in Figure 6 shows the program's standard menu. The three top-level items (File, Edit, and Options) appear across the menu bar near the top of the program's window. As seen in Figure 6, the Options item has been selected to display a submenu descending from the main menu bar; the Speed option on that submenu has been selected to display another submenu to the right of the Speed option. The Presentation Manager's ability to use nested submenus is an advance beyond what *Microsoft Windows* offers. This enhancement turns out to be important in implementing the pop-up menu.

Figure 7 shows the pop-up menu in use. When you click the right mouse button in the client window, the three top-level items are arranged vertically in a small window. The upper-left corner of the window is at the mouse pointer position. You can then use the left mouse button to select items. As in Figure 6, I've selected the Options item, which shows a submenu to its right, and the Speed option, which puts another submenu to *its* right.

Unlike a normal Presentation Manager menu, this pop-up menu has no keyboard interface. You use the left mouse button to

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- [ ] 286 systems
- [ ] 386 systems
- [ ] Peripherals
- [ ] Other

B. Are you an:
- [ ] End user
- [ ] Consultant
- [ ] Reseller
- [ ] Corporate purchaser
- [ ] DP/MIS
- [ ] Business owner

C. How many business PCs do you now have installed?
- [ ] 1-25
- [ ] 26-100
- [ ] Over 100

D. How many PCs does your company plan to purchase in the next 12 months?
- [ ] 1-25
- [ ] 26-100
- [ ] Over 100

E. What is your primary computing interest?
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DIRECT NUMBER _____

A. Which products interest you most?
- [ ] 8088/8086 class systems
- [ ] 286 systems
- [ ] 386 systems
- [ ] Peripherals
- [ ] Other

B. Are you an:
- [ ] End user
- [ ] Consultant
- [ ] Reseller
- [ ] Corporate purchaser
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- [ ] Business owner

C. How many business PCs do you now have installed?
- [ ] 1-25
- [ ] 26-100
- [ ] Over 100

D. How many PCs does your company plan to purchase in the next 12 months?
- [ ] 1-25
- [ ] 26-100
- [ ] Over 100

E. What is your primary computing interest?
- [ ] Corporate/Institutional
- [ ] Small business
- [ ] Student/Educational
- [ ] Home

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select items; the right mouse button only invokes the pop-up menu itself. When you make a selection, the pop-up menu disappears. To dismiss the menu without making a selection, you press the left mouse button when its pointer is outside the pop-up menu's windows. The pop-up menu then disappears and the mouse click has no effect on the window below.

A TALE OF TWO TEMPLATES

Let's take a look at the source code to see how this enhancement of the standard interface is accomplished. First, direct your attention to POPMENU.RC. This is the resource script file, which contains templates for the program's normal and pop-up menus and for the dialog box, as well.

The template for the normal menu begins with the line

```
MENU ID_NORMAL
```

MENU is a keyword recognized by the resource compiler. ID_NORMAL identifies a constant defined in the POP-MENU.H header file. The POPMENU.C program uses this constant to refer to the menu.

The normal menu is standard stuff. The template is organized with the usual hierarchy of menu items. All items that invoke submenus are indicated by the SUBMENU keyword. A SUBMENU statement must be followed by a pair of curly brackets that contain the items on the submenu. The MENUITEM keyword indicates an option that can be chosen by the user. The tildes (˜) in the text strings indicate the letter that is underlined in the menu. This is the key-letter for the menu's keyboard interface. All the items the user can choose are followed by constant identifiers (these are defined in POPMENU.H) that begin with the prefix IDM (ID for a Menu item). The Presentation Manager uses these ID numbers to identify chosen menu items to the program.

The pop-up menu begins with the following line:

```
MENU ID_POPUP
```

Its organization is similar to that of the normal menu. Note, however, that it begins with a SUBMENU statement in which the rest of the menu is nested. If you were to

```
/*-----------------------------------
   POPMENU.RC resource script
  -----------------------------------*/

#include <os2.h>
#include "popmenu.h"

MENU ID_NORMAL
    {
    SUBMENU "˜File",                 -1
        {
        MENUITEM "˜New",               IDM_NEW
        MENUITEM "˜Open",              IDM_OPEN
        MENUITEM "˜Save",              IDM_SAVE
        MENUITEM "Save ˜As",           IDM_SAVEAS
        MENUITEM SEPARATOR
        MENUITEM "A˜bout PopMenu...",  IDM_ABOUT
        }
    SUBMENU "˜Edit",                 -1
        {
        MENUITEM "Cu˜t",               IDM_CUT
        MENUITEM "˜Copy",              IDM_COPY
        MENUITEM "˜Paste",             IDM_PASTE
        MENUITEM "C˜lear",             IDM_CLEAR
        }
    SUBMENU "˜Options",              -1
        {
        SUBMENU "˜Color",            -1
            {
            MENUITEM "˜Red",           IDM_RED
            MENUITEM "˜Green",         IDM_GREEN
            MENUITEM "˜Blue",          IDM_BLUE
            }
        SUBMENU "˜Size",             -1
            {
            MENUITEM "˜Small",         IDM_SMALL
            MENUITEM "˜Medium",        IDM_MEDIUM
            MENUITEM "˜Large",         IDM_LARGE
            }
        SUBMENU "S˜peed",            -1
            {
            MENUITEM "˜Slow",          IDM_SLOW
            MENUITEM "˜Medium",        IDM_MEDSPEED
            MENUITEM "˜Fast",          IDM_FAST
            }
        }
    }

MENU ID_POPUP
    {
    SUBMENU "",                      IDM_POPUP
        {
        SUBMENU "˜File",             -1
            {
            MENUITEM "˜New",           IDM_NEW
            MENUITEM "˜Open",          IDM_OPEN
            MENUITEM "˜Save",          IDM_SAVE
            MENUITEM "Save As",        IDM_SAVEAS
            MENUITEM SEPARATOR
            MENUITEM "About PopMenu...", IDM_ABOUT
            }
        SUBMENU "˜Edit",             -1
            {
            MENUITEM "˜Cut",           IDM_CUT
            MENUITEM "˜Copy",          IDM_COPY
            MENUITEM "˜Paste",         IDM_PASTE
            MENUITEM "˜Clear",         IDM_CLEAR
            }
        SUBMENU "˜Options",          -1
            {
            SUBMENU "˜Color",        -1
                {
                MENUITEM "˜Red",       IDM_RED
                MENUITEM "˜Green",     IDM_GREEN
                MENUITEM "˜Blue",      IDM_BLUE
                }
            SUBMENU "˜Size",         -1
                {
                MENUITEM "˜Small",     IDM_SMALL
                MENUITEM "˜Medium",    IDM_MEDIUM
                MENUITEM "˜Large",     IDM_LARGE
                }
```

Figure 3: The POPMENU.RC resource script contains templates for the menus and dialog box.

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```
            SUBMENU "Speed",           -1
                {
                    MENUITEM "Slow",        IDM_SLOW
                    MENUITEM "Medium",      IDM_MEDSPEED
                    MENUITEM "Fast",        IDM_FAST
                }
            }
        }
    }

DLGTEMPLATE IDD_ABOUT
    {
        DIALOG "", 0, 32, 32, 200, 100, , FCF_DLGBORDER
            {
                CTEXT "PopMenu"                              -1, 10, 76, 180, 8
                CTEXT "PC Magazine, Vol. 8 No. 20"           -1, 10, 52, 180, 8
                CTEXT "(c) 1989, Ziff Communications Co."    -1, 10, 42, 180, 8
                CTEXT "Programmed by Charles Petzold, 8/89"  -1, 10, 32, 180, 8
                DEFPUSHBUTTON "OK",           DID_OK, 80, 8, 40, 16, WS_GROUP
            }
    }
```

use such a template for a program's normal menu, only one option would appear on the main menu bar; everything else would be in submenus. I have given this item a blank text string (as we will see, it is not displayed anyway) and the identifier IDM_POPUP.

I've also removed all the tildes from the text strings in this template, since there is no keyboard interface on the pop-up menu. Otherwise, everything is the same as in the normal menu template.

MENU OVERHEAD

Now let's turn to POPMENU.C, the C source code file. Including the normal menu in the program's window is easy; it involves only some data and code near the beginning of the main function. Specifically, all you need to do is include the FCF_MENU identifier with all the other FCF (frame creation flag) identifiers and to specify the menu identifier (ID_NORMAL) as the penultimate parameter to WinCreateStdWindow.

Whenever the user chooses an item from the menu, the client window receives a WM_COMMAND message. You'll notice in ClientWndProc (the window procedure for the client window), that POPMENU ignores all menu items except IDM_ABOUT, to which the program responds by displaying a dialog box.

The overhead for the pop-up menu begins when the client window is first created and receives a WM_CREATE message. The program calls WinLoadMenu with ID_POPUP as the last parameter, in order to load the menu template from the program's resources and turn the template into

a menu window. The function returns a handle to the menu window, which is stored in the static variable hwndMenuPopup. The menu window now exists, but it is not visible, because it has horizontal and vertical dimensions of zero.

Just to be on the safe side, since the menu window is not documented as being created with a zero size, the WinSetWindowPos function is called to set the size to zero explicitly. (This particular function can accomplish quite a few tasks; it will be used later to set the position of the menu window.)

ANATOMY OF A MENU

Although we speak of a menu and of a menu window, menus are really collections of multiple windows. In the Presentation Manager, windows are always rectangular. One window is required for the horizontal menu bar. This is called the top-level menu. Each submenu requires its own window.

The WinLoadMenu function creates all the windows and returns the handle to the top-level menu window. In POPMENU, the function creates eight windows: the top-level menu window and one window for each of the seven submenus.

The top-level menu is not visible, because it has zero dimensions. If this top-level menu window had a nonzero dimension, it would consist of a horizontal menu bar with only one item in it—the item indicated by the first SUBMENU statement in the template (which, in this case, happens to be a blank string).

The seven submenus are not visible either. Submenus are always initially made children of a special window known as HWND_OBJECT. The children of HWND_OBJECT are known as *object windows*, and object windows are not visible on the screen. To display a submenu, the top-level menu changes the parent of the submenu window from HWND_OBJECT to HWND_DESKTOP, the desktop

POPMENU.H   COMPLETE LISTING

```
/*----------------------------
    POPMENU.H header file
 ----------------------------*/

#define ID_NORMAL       1
#define ID_POPUP        2

#define IDM_NEW         1
#define IDM_OPEN        2
#define IDM_SAVE        3
#define IDM_SAVEAS      4
#define IDM_ABOUT       5
#define IDM_CUT         6
#define IDM_COPY        7
#define IDM_PASTE       8
#define IDM_CLEAR       9
#define IDM_RED         10
#define IDM_GREEN       11
#define IDM_BLUE        12
#define IDM_SMALL       13
#define IDM_MEDIUM      14
#define IDM_LARGE       15
#define IDM_SLOW        16
#define IDM_MEDSPEED    17
#define IDM_FAST        18

#define IDM_POPUP       20

#define IDD_ABOUT  *    1
```

Figure 4: The POPMENU.H header file contains definitions of the constants required by both POPMENU.C and POPMENU.H.

POPMENU.DEF   COMPLETE LISTING

```
;-------------------------------------
; POPMENU.DEF module definition file
;-------------------------------------

NAME            POPMENU     WINDOWAPI

DESCRIPTION     'Popup Menu (c) 1989, Ziff Communications Co.'
PROTMODE
HEAPSIZE        1024
STACKSIZE       8192
EXPORTS         ClientWndProc
                AboutDlgProc
```

Figure 5: POPMENU.DEF holds information LINK uses in constructing POPMENU.EXE.

Environments

window. (It can do this by calling WinSet-Parent.) This causes the submenu to become visible on the screen. When the top-level menu window wishes to hide the submenus again, it changes the parent back to HWND_OBJECT. This is all handled internally in the menu logic within the Presentation Manager.

The first parameter of the WinLoad-Menu function is a window handle. I used hwnd, the handle to the client window. The WinLoadMenu function assigns this window as both the parent and the owner of the top-level menu window. The owner relationship is very important: when a user chooses an item from the menu, the menu window will send a WM_COMMAND message to its owner. Because we want the WM_COMMAND messages to come to the client window, the client window must be the owner of the top-level menu window.
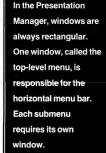
You'll notice that the final step concludes WM_CREATE processing in POP-MENU by calling WinSetParent to set the parent of the top-level menu window to HWND_DESKTOP. I do this because . . . well, because I couldn't get the program to work right otherwise! I confess I'm not quite sure *why* this is necessary, but it is.

INVOKING THE POP-UP

The pop-up menu must be invoked when the right mouse button is pressed and re-

> In the Presentation Manager, windows are always rectangular. One window, called the top-level menu, is responsible for the horizontal menu bar. Each submenu requires its own window.

leased. When the client window receives a WM_BUTTON2UP message, it first calls WinQueryPointerPos to obtain the coordinates of the mouse pointer relative to the lower-left corner of the screen. These coordinates are stored in a POINTL structure named ptlMouse. For reasons I'll explain shortly, the y-coordinate must be adjusted by adding a value obtained from the WinQuerySysValue function.

The program then calls WinSetWindowPos to set the position of the lower-left corner of the top-level menu window relative to the lower-left corner of its parent (the desktop window). This requires passing the two fields of the ptlMouse structure, along with the identifier SWP_MOVE, as parameters to the WinSetWindowPos function.

Environments

Nothing is yet visible on the screen. The top-level menu window still has a dimension of zero, and that will not change. We now need to force the top-level menu window to invoke the first pop-up window—the window, as seen in Figure 7, that contains the three items, File, Edit, and Options. This is done by simply sending a message named MM_SELECTITEM to the top-level menu window with a call to WinSendMsg. This procedure causes the menu to display the first submenu window.

This submenu window is positioned by the top-level menu window. The position of the submenu is set so that the top of the submenu window touches the bottom of the top-level menu window. Apparently, however, the top-level menu calculates this position by subtracting the standard height of menu bars from the top of the window. This doesn't work quite right because this top-level menu happens to have a zero height. That's why I first adjust the y field of the ptlMouse by adding the standard height of menu bars. (This information is available from WinQuerySysValue.) This adjustment causes the upper-right corner of the submenu to be positioned at the mouse pointer.
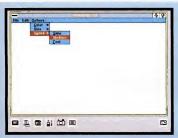
The final step required is to call WinSetCapture on behalf of the menu window in order to force all mouse input to go to the menu window. This ensures that the menu window will recognize when the left mouse button has been pressed outside the menu and will dismiss all the submenu windows.

> WinSetCapture ensures that the menu window will recognize when the left mouse button has been pressed outside the menu and will dismiss all the submenu windows.

And that's it! A total of eight Presentation Manager function calls (and very little ancillary code) is all that's required to implement pop-up menus.

OBJECT ORIENTED?

I got the idea to attempt a pop-up menu after looking at an unreleased PM application that did something similar. This is a large application that creates several different types of standard windows. In some of these standard windows, the client window is separated into several rectangular areas by child windows. Each of these child windows is responsible for a different task. In such windows, the program implements several different pop-up menus. The pop-up menu you get depends on the child window in which the mouse pointer is positioned when you press the right button.

This technique seems to me to exemplify a rather object-oriented approach to menu design. Each child window has certain commands associated with it, and the pop-up menu need contain only those commands. Each child window is responsible for displaying data (and sometimes receiving user input) of a specific sort, so the pop-up menu lists only those commands that the particular child window understands. The main menu in these windows lists all the commands that all the windows understand.

For a program organized in this way, the pop-up menus make a lot of sense. Perhaps someday they will be explicitly supported in the Presentation Manager and will require only one function call rather than eight. That would be a very nice enhancement to the PM user interface. ∎

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by
Ray Duncan

Power Programming

Arithmetic Routines For Your Computer Programs, Part 2

Last time, I discussed single- and double-precision integer arithmetic operations on the 80x86 family of processors. In this column, I want to generalize those techniques to cover integer addition, subtraction, and multiplication using any precision you might want or need in your programs. In the next installment, I'll talk a little more about multiplication and then address multiple-precision division.

Before beginning, a brief digression into the more-treacherous waters of data formats is in order.

BIG-ENDIANS AND LITTLE-ENDIANS

When you program in a high-level language, you generally do not need (or want) to know how the component bytes of an arithmetic value are laid out in memory. If you program in an assembly language, on the other hand, an understanding of binary data formats is absolutely vital. If you are going to load an integer from memory into registers (or vice versa), you clearly need to know which end of the integer is which.

You may be surprised to hear that the world is divided into two hostile camps (wags have dubbed them the "Big-Endians" and the "Little-Endians" over this seemingly innocuous issue. The Big-Endians are committed to a data format that puts the most significant byte of an integer at the lowest memory address, the next most significant byte at the next-higher address, and so on. The Little-Endians, by contrast, are firm believers in a data format in which the least significant byte of the number is placed at the lowest memory address and the most significant byte at the highest memory address occupied by the number.

To make the difference in storage techniques more concrete, consider the 32-bit integer 12345678h, which is composed of four bytes. On a Little-Endian CPU, the four bytes would be layed out in memory as

    78h 56h 34h 12h

with 78h occupying the lowest address and

> ■ This installment covers addition, subtraction, and multiplication, both in generalized C-like form and in full assembly language routines.

12h the highest. On a Big-Endian CPU, on the other hand, again moving upward from the lowest to the highest address, the four bytes would be arranged in memory as follows:

    12h 34h 56h 78h

Although there are many different examples of CPUs that use each of these data formats, the front lines in this silly little war are manned by the Intel 80x86 users on the side of the Little-Endians and the Motorola 680x0 users on the side of the Big-Endians. When a Macintosh programmer meets a PC programmer, I'm often amazed at the intensity of the feelings aroused by this seemingly trivial issue.

Before you get involved in any such heated discussions yourself, just remember that these data formats are only conventions and that equally efficient CPUs can be built using either one. The Little-Endian approach, in which the significance of a byte ascends with its address, seems perfectly logical and intuitive to me, but I'll be the first to admit that hex dumps of memory are far easier to read and interpret on a Big-Endian machine. In any event, I'll be using the Little-Endian for-

mat exclusively in the arithmetic routines to be developed in this column, both for the sake of consistency and to make it easier to plug in the use of an 80x87 numeric coprocessor later.

Interestingly, the 80486 processor has a new instruction, called BSWAP, whose only purpose is to transform a 32-bit data value in a register from Big-Endian format to a Little-Endian format or back again. In other words, it performs the same function on 32-bit values as the XCHG instruction does on 16-bit values. For example, if you had a 32-bit value in register EAX, the instruction

    BSWAP EAX

would be exactly equivalent to (but much faster than) the sequence

    XCHG AH,AL
    ROL EAX,16
    XCHG AH,AL

MULTIPLE-PRECISION ALGORITHMS

Whenever you need to perform addition, subtraction, multiplication, or division to a degree of precision beyond what your CPU's native machine instructions support, you are led directly to the so-called classical algorithms for these operations. The *classical algorithms* are the underpinnings of the stepwise, methodical procedures we all learned in grade school, using paper and pencil, for doing arithmetic on numbers with more than one digit. They are called *classical* because their history extends far back before the dawn of

Power Programming

computer age. In fact, as Donald Knuth points out, the word "algorithm" was used exclusively in this sense for several centuries, before it acquired its modern, more general meaning.

Figures 1 through 3 contain C-like pseudo-code that demonstrates the classical algorithms for addition, subtraction, and multiplication. (I'm deferring multiple-precision division to the next installment.) The pseudo-code shown is modeled on Knuth's MIX assembly language listings in *The Art of Computer Programming, Volume II: Seminumerical Algorithms* (section 4.3), a definitive work that should always be your ultimate recourse on these and related topics.

In Figures 1 through 3, u[] and v[] are arrays that hold arguments in base b, one digit per array element. The actual physical size of each array element is irrelevant, so long as it is large enough to hold a number of magnitude b−1. The value m represents the maximum number of digits in each argument, and the result is formed in array w[]. The variable k represents the "carry," which is set to the excess when the result of an operation does not fit into a single digit.

To illustrate how these arrays and variables are used, let's consider what happens when we add the very first digits of two multiple-precision numbers together. The value of the first result digit and the resulting carry are found as follows:

w[0] = (u[0] + v[0]) mod b
k   = (u[0] + v[0]) / b

Subsequent digits (1 through m−1) in the result are found in the same way, except that the previous value of k is included, as follows:

w[i] = (u[i] + v[i] + k) mod b
k   = (u[i] + v[i] + k) / b

One interesting aspect of these classical algorithms is that they apply equally well to numbers in any base whatever. You can choose to view your arguments and results as bit arrays (base 2), or you can gang the bits together and work on octal numbers (base 8) or hexadecimal numbers (base 16); you can even allow the natural byte or word size of the CPU to be an individual "digit."

ADDITION PSEUDO-CODE — COMPLETE LISTING

```
int m;              // number of digits
int i;              // index variable
int b;              // base
int k;              // carry

array u[m], v[m];   // holds arguments
array w[m];         // receives results

k = 0;              // initialize carry

for(i = 0; i < m; i++) {   // add digit by digit
    w[i] = (u[i] + v[i] + k) mod b
    k    = (u[i] + v[i] + k) / b
}
```

Figure 1: In this simplified, C-like pseudo-code for multiple-precision addition, both arguments and the result are assumed to be nonnegative. The carry k always takes the value 0 or 1.

SUBTRACTION PSEUDO-CODE — COMPLETE LISTING

```
int m;              // number of digits
int i;              // index variable
int b;              // base
int k;              // carry

array u[m], v[m];   // holds arguments
array w[m];         // receives results

k = 0;              // initialize carry

for(i = 0; i < m; i++) {   // subtract digit by digit
    w[i] = (u[i] - v[i] + k) mod b
    k    = (u[i] - v[i] + k) / b
}
```
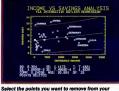
Figure 2: Multiple-precision subtraction in C-like pseudo-code. In this simplified presentation, both arguments and the result are assumed to be nonnegative, and the argument in array u[] is assumed to be greater than or equal to the argument in v[]. The carry k always takes the value 0 or −1.
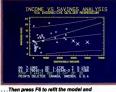
MULTIPLICATION PSEUDO-CODE — COMPLETE LISTING

```
int m;              // number of arg. digits
int i, j;           // index variables
int b;              // base
int k;              // carry
int t;              // scratch variable

array u[m], v[m];   // holds arguments
array w[m*2];       // receives product

for(i = 0; i < m*2; i++);  // initialize product
    w[i] = 0;

for(i = 0; i < m; i++) {   // sum partial products

    k = 0;          // initialize carry

    for(j = 0; j < m; j++) {   // find this partial product
        t = u[j] * v[i] + w[i+j] + k;
        w[i+j] = t mod b;      // digit of partial product
        k = t / b;             // calculate carry
    }

    w[i+m] = k;     // highest digit of
                    // partial product
}
```

Figure 3: This C-like pseudo-code for multiple-precision multiplication exploits the CPU's native multiply instruction. The square of the base must be less than or equal to the largest product that can be generated by the hardware's unsigned multiply instruction. In this simplified presentation, both of the arguments and the result are assumed to be nonnegative, and both arguments are the same size. The value of the carry k always satisfies the condition 0 <= k < b, where b is the base.

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The multiplication algorithm shown here differs slightly from the longhand technique you probably learned in school, in that the partial products are accumulated on the fly. When you perform long multiplication with pencil and paper, you normally find all the partial products first, then add them all up at the end of the calculation.

One particularly nice feature of this version of the multiplication algorithm is that it lets you use your CPU's native hardware multiply, if one is available. You need only pick a base such that the square of the base is less than or equal to 1 plus the largest product that can be generated by the CPU's unsigned multiply instruction. If no hardware multiply is available, of course, you simply fall back on base 2, in which case the algorithm degenerates into the

MPNEG.ASM

COMPLETE LISTING

```
        title   MPNEG.ASM Multiple-Precision 2's Complement
        page    55,132
;
; MPNEG.ASM    Multiple-Precision 2's Complement routine
;              for Intel 8086, 8088, 80286, and
;              80386 in real mode/16-bit protected mode
;
; Copyright (C) 1989 Ziff Communications Co.
; PC Magazine • Ray Duncan
;
; Call with:   DS:SI = address of argument
;              CX    = argument length in bytes
;              Assumes direction flag is clear at entry
;
; Returns:     ES:DI = address of result
;
; Destroys:    Nothing
;
_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  mpneg
mpneg   proc    near

                mov     di,si           ; save address of result
                push    cx              ; save two copies of
                push    cx              ; argument length
mpneg1:         not     byte ptr [si]   ; 1's complement this digit
                inc     si              ; advance through argument
                loop    mpneg1          ; until all digits inverted

                pop     cx              ; retrieve length of argument
                mov     si,di           ; retrieve first-byte address
                stc                     ; set carry to add 1
mpneg2:         adc     byte ptr [si],0 ; add 1 to 1's complement
                inc     si              ; to get 2's complement
                loop    mpneg2          ; until all digits finished

                pop     cx              ; restore operand length
                mov     si,di           ; restore argument address
                ret                     ; back to caller

mpneg   endp
_TEXT   ends
        end
```

Figure 4: MPNEG.ASM is a general-purpose two's complement routine that changes the sign of multiple-precision integers.

MPADD.ASM

COMPLETE LISTING

```
        title   MPADD.ASM Multiple-Precision Integer Addition
        page    55,132
;
; MPADD.ASM    Multiple-Precision Integer Addition
;              for Intel 8086, 8088, 80286, and
;              80386 in real mode/16-bit protected mode
;
; Copyright (C) 1989 Ziff Communications Co.
; PC Magazine • Ray Duncan
;
; Call with:   DS:SI = address of source operand
;              ES:DI = address of destination operand
;              CX    = operand length in bytes
;              Assumes direction flag is clear at entry
;
; Returns:     ES:DI = address of result
;
; Destroys:    AL, CX, SI (other registers preserved)
;
_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  mpadd
mpadd   proc    near

                push    di              ; save address of result
                clc                     ; carry initially clear
mpadd1: lodsb                           ; next byte from source
                adc     byte ptr es:[di],al ; accumulate sum
                inc     di
                loop    mpadd1          ; until all bytes processed

                pop     di              ; restore address of result
                ret                     ; back to caller

mpadd   endp
_TEXT   ends
        end
```

Figure 5: MPADD.ASM is a general-purpose addition routine for multiple-precision integers.

MPSUB.ASM

COMPLETE LISTING

```
        title   MPSUB.ASM Multiple-Precision Integer Subtraction
        page    55,132
;
; MPSUB.ASM    Multiple-Precision Integer Subtraction
;              for Intel 8086, 8088, 80286, and
;              80386 in real mode/16-bit protected mode
;
; Copyright (C) 1989 Ziff Communications Co.
; PC Magazine • Ray Duncan
;
; Call with:   DS:SI = address of source operand
;              ES:DI = address of destination operand
;              CX    = operand length in bytes
;              Assumes direction flag is clear at entry
;
; Returns:     ES:DI = address of result (destination - source)
;
; Destroys:    AL, CX, SI (other registers preserved)
;
_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  mpsub
mpsub   proc    near

                push    di              ; save address of result
                clc                     ; carry initially clear
mpsub1: lodsb                           ; next byte from source
                sbb     byte ptr es:[di],al ; subtract from destination
                inc     di
                loop    mpsub1          ; until all bytes processed

                pop     di              ; restore address of result
                ret                     ; back to caller

mpsub   endp
_TEXT   ends
        end
```

Figure 6: MPSUB.ASM is a general-purpose subtraction routine for multiple-precision integers.

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Figure 7: MPMUL1.ASM is a general-purpose unsigned multiplication routine for multiple-precision integers.

Figure 8: MPIMUL.ASM is a general-purpose signed multiplication routine for multiple-precision integers.

Play It Again... Sam.

Power Programming

more familiar shift-and-add method of multiplication.

MULTIPLE-PRECISION ROUTINES
Figures 4 through 8 are the source listings of the first multiple-precision integer arithmetic modules in our Power Programming library, which are as follows:

```
MPNEG    Change sign of a multiple-
         precision integer
MPADD    Multiple-precision integer
         addition
MPSUB    Multiple-precision integer
         subtraction
MPMUL1   Multiple-precision
         unsigned integer
         multiplication
MPIMUL   Multiple-precision signed
         integer multiplication
```

The logic of the addition, subtraction, and multiplication routines follows the flow of the pseudo-code listings quite closely. The change-sign procedure employs the familiar trick of taking the one's complement of the entire integer, then adding 1.

The calling sequence for these various multiple-precision routines is documented in their source-code listings. In general, CX is used to pass the length of the arguments, which are assumed always to be the same size. DS:SI points to one argument and ES:DI points to the other. The DS:SI argument is referred to as the *source* and the ES:DI argument as the *destination*, which preserves symmetry with operand usage in the CPU's native ADD and SUB instructions.

The result of the operation always replaces the destination argument, and the address of the result is returned in ES:DI. One warning is in order: when calling the multiple-precision multiply routines, you must make certain that the buffer that holds the destination argument is twice as large as the argument itself so that it will be able to hold the product of the two arguments.

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Spreadsheet Clinic

FLEXIBLE RANGE NAMES

To name a range in *Microsoft Excel*, you issue the Define Name... command, type the range name into the Name: text box, and type the address of the range to which you want the name to refer, prefaced by an = (equals sign), into the Refers to: text box.

Typically, you use absolute references when assigning a name to a range so that it will always refer to the same range. For example, if the Name: text box contains the name Test and the Refers to: text box contains the formula =$A$1:$B$2, the name Test will refer specifically to those cells when you click OK. Consequently, entering a function such as =SUM(Test) will always return the sum of the values in cells A1, A2, B1, and B2; similarly, *Excel* will always highlight these four cells if you do the following: issue the Goto... command, specify Test, and click OK.

You can also use relative references to define a range. However, you probably won't get the results that you expect. Instead of assigning a name to the range that you specify, *Excel* will create a variable range—one that refers to different cells, depending upon where the cell pointer is when you reference it.

Let's suppose that while cell A1 is the active cell, you pull down the Formula menu, select the Define Name... command, type Temp into the Name: text box, and then click OK. If you enter the formula =SUM(Temp) into cell A1, it will sum the values in cells A2 and A3. If you enter the same formula into cell B5, however, it will sum the values in cells B6 and B7. Similarly, if you issue the Goto... command, select the name Temp, and click OK, *Excel* will highlight cells A2 and A3.

Tim Langrave
Louisville, Kentucky

Although many people will view this behavior as a hazard, it actually comes in handy in certain situations. In the course of developing an *Excel* worksheet, you'll often need to highlight

- **FLEXIBLE RANGE NAMES:** Developing Excel worksheets is easy when you use relative range names.

- **SEARCHING STRINGS:** 1-2-3's @FIND function can quickly locate substrings within a string.

- **A SHORTCUT FOR ASSIGNING CELL FORMATS:** Use these Excel key combinations to assign date and time formats in a single setup.

- **PLOTTING POINTS IN 1-2-3 GRAPHS:** Choose the wrong ASCII character to plot a graph and it may be rendered inaccurately.

- **CONVERTING LABELS INTO VALUES:** Here's a handy way to change columns of numeric, date, and time labels into values.

the active cell plus the four cells to its right. To make this process easier, create a relative named range: issue the Define Name... command, type a name (for example, RIGHT4) into the Name: text box, and type a relative reference to the range that begins with the active cell and extends four cells to the right into the Refers to: text box. For example, if cell A1 were the active cell, you would type =A1:E1. Finally, click OK.

Once you have defined this name, it's easy to extend the highlight from an active cell to the cell four cells to its right. Simply

issue the Goto... command (the F5 key provides the easiest way to do this), select the name that you assigned to the range (in this case, RIGHT4), and press Enter.

SEARCHING STRINGS

Lotus 1-2-3's @FIND function locates a substring within a string. The form of this function is

```
@FIND(substring,string,offset)
```

where *substring* is the group of characters that you want to find, *string* is the group of characters that you want to find the substring within, and *offset* is where the search should begin relative to the beginning of the string. If 1-2-3 locates the substring in the portion of the string it searches, the @FIND function will return the offset of the first character of that occurrence. If the searched portion does not contain the substring, the @FIND function will return the value ERR.

When a substring occurs more than once within a string, it is easy to determine the position of its first occurrence: simply use an @FIND function with an offset argument of 0. Let's suppose that cell A1 contains the label 'abracadabra. To locate the first occurrence of a, you'd use the function

```
@FIND("a",A1,0)
```

The result of this function—0—indicates that the first occurrence of a is as the first letter in the word.

To find subsequent occurrences of a substring, nest one @FIND function within another. The function

```
@FIND("a",A1,@FIND("a",A1,0)+1)
```

will find the second occurrence of the letter a. Since this word begins with the letter a, the formula @FIND("a",A1,0)+1 returns the value 1—the offset of the character immediately to the right of the first occurrence of the letter a in the label. Thus, the main @FIND function begins searching with the

Spreadsheet Clinic

second character in the label and returns the value 3—the offset of the second occurrence of the letter a within the label.

In order to find the third occurrence of this substring, you would use a formula that adds 1 to the function that returns the previous occurrence of the string as your offset argument. The formula would be as follows:

```
@FIND("a",A1,@FIND("a",A1,@FIND("a"
,A1,0)+1)+1)
```

This would return the value 5. Similarly, you'd use any one of the three following @ find functions:

```
@FIND("a",A1,@FIND("a",A1,@FIND("a"
,A1,@FIND("a",A1,0)+1)+1)+1)

@FIND("a",A1,@FIND("a",A1,@FIND("a"
,A1,@FIND("a",A1,@FIND("a",A1,0)+
1)+1)+1)+1)

@FIND("a",A1,@FIND("a",A1,@FIND("a"
,A1,@FIND("a",A1,@FIND("a",A1,@FI
ND("a",A1,0)+1)+1)+1)+1)+1)
```

to find the fourth, fifth, and sixth occurrences, which would return the values 7, 10, and ERR, respectively.

Daniel Swigart
Denver, Colorado

 Mr. Swigart's technique does a good job of finding a numbered occurrence of a substring within a string. But what if you are trying to find the final occurrence of a substring? The macro shown in Figure 1 describes just how you can do this.

The first two statements in this macro ask you to point to the cell that contains the label that you want to search and to assign the name STRING to that cell. The third statement asks you to specify the string that you want to locate and enters your response into the cell named SUBSTRING (B12).

The fourth statement sets up a loop that 1-2-3 will execute as many times as there are characters in the string, less the number of characters in the substring. The cell named COUNT (B13) serves as the counter for the loop. Initially, the value in COUNT will be the difference between the length of the string and the length of the substring. However, it will decrease by 1 at the beginning of each subsequent pass through the loop.

The single statement in the loop uses an @FIND function to search for the substring within the string, starting at the position specified by the COUNT statement. Consequently, the search will begin near the end of the string but will include one more character during each pass through the loop.

1-2-3 will continue to make passes through the loop until it finds an occurrence of the substring or until it has searched the entire string. In either case, 1-2-3 will break from the loop and recalculate the string formula

```
B6: +"(Let %RCELLPOINTER
     ("address")&",@IF
     (COUNT<0,@ERR,COUNT))~
```

in cell B6. The result of this particular formula is a {Let} statement that commands the *Lotus 1-2-3* program to enter the result of the following function:

```
@IF(COUNT<0,@ERR,COUNT)
```

into the current cell. If 1-2-3 has searched the entire string without finding an occurrence of the substring, COUNT will contain the value −1 and this function will return the value ERR. If 1-2-3 has located an occurrence of the substring, the value in COUNT will be the offset of that value relative to the beginning of the string.

A SHORTCUT FOR ASSIGNING CELL FORMATS

Microsoft Excel displays the results of date-producing formulas or functions in the General format unless you have previously assigned a format to that cell. To display an entry as a recognizable date, for example, you must assign a date format to the cell. To do this, you typically pull down the Format menu, select Number... , select the format, and click OK.

Fortunately, there is an easier way. Before you enter a date-producing formula or function into a cell, press Ctrl-; (semicolon) and hit Enter. This enters the serial value of the current date into the active cell. More importantly, however, it assigns the m/d/y format to this cell. Now, when you enter a date-producing formula or function into this cell, *Excel* will replace the serial date value in the active cell with this formula or function. However, the format of the cell will remain. Consequently, *Excel* displays the result of the formula or function in the m/d/yy format.

Peggy Zeilman
New York, New York

 You can use a variation of this technique to assign the hh:mm AM/PM format to a cell. Prior to entering a formula or function that returns a serial time value, press Ctrl-Shift-; (semicolon). *Excel* will enter the serial value of the current time into the active cell and, more importantly, assign that cell the hh:mm AM/PM format. Now, when you subsequently enter a time-producing formula or function into that cell, *Excel* displays the result of that formula in the hh:mm AM/PM format.

PLOTTING POINTS IN 1-2-3 GRAPHS

In the January 17, 1989, Spreadsheet Clinic, you described a method of marking data points on a graph with alternative symbols by using the /Graph Options Data-Labels

	A	B	C	D	E	F	G	H
1	\f	{GetLabel "Press [Enter], then point to the label...",NULL}						
2		/rscSTRING~{?}~						
3		{GetLabel "String to find? ",SUBSTRING}						
4		{For COUNT,@LENGTH(STRING)-@LENGTH (SUBSTRING),0,-1,LOOP}						
5		{Recalc NEXT}						
6	NEXT	{Let $C$7,@IF(COUNT<0,@ERR,COUNT)}~						
7								
8	LOOP	{If @NOT@ISERR(@FIND (SUBSTRING,STRING,COUNT))}{ForBreak}						
9								
10								
11	NULL							
12	SUBSTRING							
13	COUNT							

SUBSTRING MACRO   **COMPLETE LISTING**

Figure 1: This macro locates the final occurrence of a substring within a string.

Spreadsheet Clinic

command. To demonstrate this technique, you used the period.

Unfortunately, when Lotus 1-2-3 centers a data label at a point on a graph, it vertically centers a normal full-height character box (that is, capital letters). Lowercase letters and other characters (such as the period) that are not centered in a normal character box are plotted slightly below the actual data point. The result is an erroneous graph.

In many situations, this small plotting error is acceptable. In other cases, it makes a difference. Therefore, as a general rule, lowercase letters and periods should not be used as centered data labels to mark data points.

Rod S. March
Fairbanks, Alaska

This is correct. If you want to mark the data points on a 1-2-3 graph with a dot, use LICS character 183. This character is a dot, similar to a period. Unlike the period, however, LICS character 183 is centered vertically within the normal character box. To generate this character, press Alt-F1, type `, and then press . (period).

CONVERTING LABELS INTO VALUES

Most people use Lotus 1-2-3's /Data Parse command to break information, imported from another program, into separate entries. But it also comes in handy for converting columns of numeric labels into values.

To do this, move the cell pointer to the first entry in the column of labels that you want to convert. Then, issue the /Data Parse Format-Line Create command. This inserts a row into the worksheet and enters a format line into the current cell. Since the first character in the cell that the cell pointer was on when you issued the command was a number, the format line will begin with the letter V. This character will be followed by multiple occurrences of the character >—as many as there are characters in the value, less 1.

If the value in the cell just below the cell that contains the format line is not the longest label in the column, choose Edit from the /Data Parse Format-Line menu, press End, hit Ins, type as many >'s as are required to make the format line as long as the longest label in the column, and press

Enter on your keyboard.

Next, select Input-Column from the /Data Parse menu, highlight the single-column range that begins with the cell that contains the format line and extends down-ward to include all of the labels that you want to convert to values, and press Enter. Choose Output-Range, highlight all but the topmost cell of the range that you just highlighted, and hit Enter again.

Select Go from the /Data Parse menu and 1-2-3 will convert the numeric labels in the range that you selected into values. Quit to return to READY mode and use /Worksheet Delete Row to delete the row that contains the format line.

Byron G. Lee
Winston-Salem, North Carolina

You also can use the /Data Parse command to convert date labels into serial date values and to convert time labels into serial time values. When converting date labels, make sure that the format line begins with the letter D; when converting time labels, make sure the format line begins with the letter T. In order for this technique to work for date labels, they must be in one of the following five formats:

```
dd-mmm-yy
dd-mmm
mmm-yy
mm/dd/yy
mm/dd
```

Time labels must be in one of these four formats:

```
hh:mm:ss AM/PM
hh:mm AM/PM
hh:mm:ss
hh:mm
```

Unfortunately, this technique will not convert values into labels. To do this, you should use the @STRING function or the {Contents} command.

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by
Neil J. Rubenking

User-to-User

SUSPENDING BATCH FILE EXECUTION

DOS offers only the PAUSE command to suspend batch file execution. PAUSE requires user input for an operation to continue, so it is well suited to displaying warnings before potentially ruinous commands are executed. Sometimes, however, you don't need or want user intervention.

DELAY.BAT (Figure 1) temporarily halts batch file execution and, after a short time, lets it continue. The length of time that a message is displayed depends on two factors: the number of entities in the set defined by the FOR...IN...DO parentheses, and the speed at which the particular computer can execute the DIR command. My UTIL directory has many files, which makes it a prime candidate for DELAY.BAT. The NUL device receives the redirected output from the DIR command, preventing output to the screen.

You can use DELAY.BAT to display user-friendly information, such as notes before infrequently used procedures. You can insert these lines wherever you desire in your batch file, or you may create a more extensive version and call it as a separate batch file.

Two other operating-system commands, TYPE and COPY, could also be used in this manner to produce a delay in batch file execution.

Michael Ross
Carlsbad, California

- **SUSPENDING BATCH FILE EXECUTION:** Halt and restart your batch files without user input.

- **RENAMING SUBDIRECTORIES:** Tiny RED.COM renames subdirectories for you, even in DOS 2.0.

- **SAVING DISK SPACE:** Shrink your batch files by setting environment variables to common words or phrases.

- **CURSOR CONTROL:** A tiny program that sets the shape of your cursor and solves a problem with some monochrome displays.

PC Some batch programs can benefit from a command that suspends operation for a short while but doesn't require user intervention. However, I don't approve of using DIR, TYPE, or COPY to create the delay. In effect, this method uses your hard disk as a "friction brake" for your batch files! The exact delay time will vary wildly, depending on the speed of the system and possibly on any disk-caching software installed.

I created a tiny program, WAIT-10.COM, to address this problem. The DEBUG script that will create this program is shown in Figure 2. Type it in exactly as shown. Don't forget the blank before the W and after the Q. Then enter the following command

```
DEBUG < WAIT10.SCR
```

WAIT10 watches the timer-tick count that DOS keeps in low memory. This count increases by one about 18.2 times per second. All WAIT10 does is add 18.2 times 10 (182, or B6 in hexadecimal) to the current count and wait for the tick count to be greater than that amount. WAIT10 looks only at the lower 2 bytes of the 4-byte tick count, so there's a chance that the low part of the count could overflow and start again at 0. Each hour there's a 10-second period in which this could happen. But don't worry—WAIT10 takes that into account.

If you want a longer wait, you can just use a FOR loop to add 10-second increments. For example, to add a delay of 1 minute, use

```
FOR %%v IN (1 2 3 4 5 6) DO WAIT10
```

in your batch file.

You may wish to modify WAIT-10.SCR to use a basic unit other than 10 seconds. Multiply the number of seconds you want by 18.2, and round off any fraction. Convert that number to hexadecimal, then replace the number B6 with the number you derived. Now subtract that number from hexadecimal 10000h and replace the number FF4A with the result of that subtraction. Do this carefully, because an arithmetic error could produce a program that will wait for an hour or more!

DELAY.BAT   COMPLETE LISTING

```
::::::::By Michael Ross::::::::
ECHO OFF
FOR %%p IN (a b c d e f g h i j k
    l m n o p) DO DIR C:\UTIL > NUL
```

Figure 1: These batch lines will suspend your batch file for a short while.

WAIT10.SCR   COMPLETE LISTING

```
NWAIT10.COM
RCX
21
N 100
MOV     AX,0040
MOV     DS,AX
MOV     BX,[006C]
ADD     BX,FF4A
JB      0116
MOV     WORD PTR [006C],+00
JLE     010F
ADD     BX,0086
CMP     BX,[006C]
JA      011A
RET
```

Figure 2: This script creates WAIT10.COM. Use it in a batch file for a 10-second delay.

User-to-User

RENAMING SUBDIRECTORIES

One of the little annoyances inherent in DOS is its inability to rename subdirectories. I created RED.COM to overcome this shortcoming.

RED stands for REname Directory. Like RENAME, RED takes two arguments, the old directory name followed by the new one. Neither name can include a path. For example, the command

```
RED WP WORDPRO
```

changes the name of the WP directory to WORDPRO. Figure 3 contains a DEBUG script that will create RED.COM. Copy everything—except the comments—to a file called RED.SCR. Then type

```
DEBUG < RED.SCR
```

This will create a file called RED.COM. Now you should be REDy to rename those directories.

Geoff Friesen
Dauphin, Manitoba, Canada

You may wonder how RED .COM, 61 bytes in size, can perform the same task as PC Magazine's own RENDIR.COM, which weighs in at 1,139 bytes. The answer is that the two programs are *not* actually performing the same tasks. RED uses older DOS functions that work through an Extended File Control Block and cannot handle pathnames. You can use RED only on a subdirectory of the current directory.

Note, though, that because it uses "old-fashioned" functions, RED will work in any version of DOS back to 2.0, while RENDIR works only in DOS 3.0 and later. Some of its 1,139 bytes are devoted to checking that the DOS version being used is at least 3.0, and halting with an error message if it is not.

RED has only one message, "Unable to rename directory." If for any reason RED can't do its job, that's the message you'll get. After a successful rename, RED says nothing at all.

SAVING DISK SPACE

If your hard disk's cluster size is 2K (a common size), the tiniest file will take up at least 2K of disk space, and a file even 1 byte longer will use 4K. Condensing a number of

short batch files into a single master file is one way to regain disk space. However, this usually involves using a utility that modifies ERRORLEVEL based on keyboard input, checking a number of IF ERROR-LEVEL statements and finally branching to the appropriate section of the batch file. A complicated batch file with several checks and branches can quickly exceed the 2K limit.

Substituting a short environment variable in place of a commonly used command, such as ERRORLEVEL, will reduce

Figure 4: After running this batch file, you can replace various batch commands with one-letter abbreviations.

the size of a batch file. For example, place the command

```
SET e=ERRORLEVEL
```

early in a batch file and replace every subsequent occurrence of the word ERROR-LEVEL with %e%. This SET command adds 17 bytes to a batch file; every substitution will shorten the batch file by 7 bytes. Thus, for a batch file with ten occurrences of the word ERRORLEVEL, the length will be reduced by a total of 53 bytes. [Making a 3-byte substitution—%e%—for the 10-character ERRORLEVEL saves 7 bytes for each occurrence of the word ERROR-LEVEL, or a savings of 70 bytes if the substitution is made ten times. If the 17 bytes necessary for the initial SET statement are subtracted from the 70-byte savings, the net amount saved is 53 bytes.—Ed.] This could save you as much as 2,000 bytes of disk space.

William T. Maynard
Bowie, Maryland

Figure 3: Redirect this file into DEBUG to produce RED.COM, a utility that renames subdirectories.

Figure 5: This batch file doesn't do anything useful—it just uses some common batch commands.

PC MAGAZINE Shrinking batch files like this makes them harder to read. But if you're the only one who *needs* to read them, this may not be a problem. If the command you're abbreviating is a common one, why not move the SET command from the individual batch file to your AUTOEXEC. Once the abbreviations are in the AUTOEXEC, any batch file can use them. The batch file in Figure 4 sets abbreviations that I'd find useful myself.

Figure 5 selects one of two actions using the imaginary program CHOOSE. Figure 6 shows the same batch file as it would look if the environment variables shown in Figure 4 had been created.

SHORT2.BAT   COMPLETE LISTING

```
%e1
CHOOSE
IF %e1 2 GOTO files
REM % v1 GOTO rubbish
:files
%i%*.%a% %t% (*.BAT) DO TYPE %%v
%g
:rubbish
%i% (DUM*.BAT) DO %t %%v
%e
```

Figure 6: Since this batch file uses the abbreviations in Figure 4, it takes up less disk space.

Using these variables knocks off 30 percent of the file size. Note that unless the shrinking brings your file below a cluster-size boundary, it serves no purpose. But if you're already working at saving space by combining many batch files into one, this can help reduce its size even further.

CURSOR CONTROL

I find that various programs alter the appearance of the cursor on my monochrome display.

CURSOR.SCR   COMPLETE LISTING

```
A 100
MOV AH,01
MOV CH,01
MOV CL,P0
INT 10
INT 20

RCX
0
W
Q
N CURSOR.COM
```

Figure 7: The DEBUG script for CURSOR .COM, which simply restores the cursor when a program has wiped it out.

MCURSOR.BAT   COMPLETE LISTING

```
ECHO OFF
IF "%2"=="" GOTO BadParams
FOR %%v IN (0 1 2 3 4 5 6 7 8 9 A B C D a b c d) DO IF %%v==%1 GOTO OK1
GOTO BadParams
:OK1
FOR %%v IN (0 1 2 3 4 5 6 7 8 9 A B C D a b c d) DO IF %%v==%2 GOTO OK2
GOTO BadParams
:OK2
ECHO Creating DEBUG script to set cursor lines to %1 and %2
ECHO A 100 > CURSOR.$$$
ECHO MOV AH,01 >> CURSOR.$$$
ECHO MOV CH,%1 >> CURSOR.$$$
ECHO MOV CL,%2 >> CURSOR.$$$
ECHO INT 10 >> CURSOR.$$$
ECHO INT 20 >> CURSOR.$$$
REM Using MORE in the next line gets an extra
REM blank line before Q, which is necessary to
REM end the Assemble mode.
ECHO Q | MORE >> CURSOR.$$$
ECHO G >> CURSOR.$$$
ECHO NOW RUNNING the DEBUG script
DEBUG < CURSOR.$$$ > NUL
DEL CURSOR.$$$
GOTO End
:BadParams
ECHO SYNTAX: "MCURSOR top bot", where top and bot are hex numbers
ECHO 0-9 or A-D.
:End
```

Figure 8: MCURSOR.BAT lets you experiment with different cursor shapes.

display and fail to restore it upon exiting. Depending upon the program, my cursor can be left as a box, rectangle, or line, the latter often blinking right in the middle of a character display position.

CURSOR.COM redefines the cursor as a blinking line at the bottom of a character display position. You can create CURSOR .COM by redirecting CURSOR.SCR, shown in Figure 7, into DEBUG:

```
DEBUG < CURSOR.SCR
```

If you have a preference for another cursor style, you can easily alter the starting and ending scan lines of the cursor using DEBUG. Remember to include the blank line before RCX and after the final Q.

A monochrome display adapter can display a cursor of up to 14 lines, numbered from 0 at the top to 13 (0D in hex) at the bottom. A CGA can display an 8-scan-line cursor, numbered from 0 at the top to 7 at the bottom. Experimenting with the values at the starting and ending scan lines of the cursor in CURSOR.SCR will vary the appearance of the cursor.

Andrew C. Coyne
Somerville, New Jersey

PC MAGAZINE Some monochrome systems have a cursor problem when they're first turned on. On the screen, the cursor properly occupies the 13th and 14th scan lines. However, the BIOS data area contains the numbers 6 and 7. Hence, if a program properly queries the BIOS about the current cursor shape, and then restores it on exit, it will produce a cursor that's incorrectly shaped. Running CURSOR .COM in AUTOEXEC.BAT will fix this problem.

To make it easier for you to play with cursor shapes, I've written MCURSOR .BAT, shown in Figure 8. Just pass the top and bottom scan lines you want to use as parameters to MCURSOR. To get a box cursor, set the top line to 0 and the bottom line to the maximum—D on a monochrome system, 7 on a color. For really strange results, set the top line lower than the bottom. MCURSOR 0 gives a "split-level" cursor (on a color system use 7 and 0). If you find a cursor shape you especially like, you can edit CURSOR.SCR to create a version of CURSOR.COM that will produce that shape. MCURSOR refuses parameters other than 0–9 and A–D, but it's up to you to remember to use only 0–7 if you have a color monitor.

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Power User

SIMULATING DEFAULTS

Microsoft Word uses Courier for the default font on an HP LaserJet II printer. Microsoft technical support insists that you can't reset the default to something else, such as a Letter Gothic cartridge font. However, you can get the same effect with style sheets.

Word tries to attach a style sheet to every document and uses the file NORMAL.STY unless told otherwise. Therefore, the settings in NORMAL.STY affect *Word's* default settings.

To change NORMAL.STY's default settings, press Esc-G to load *Word* and enter the Gallery. (If you don't already have a NORMAL.STY on your disk, the gallery will be empty. In this case, you will have to create a Standard Paragraph before you can format it. To do this, press Esc to enter the menu and choose Insert; name the paragraph SP for Standard Paragraph; tab to the Usage field and press P for Paragraph; tab to the Variant field and press F1 to highlight Standard; and hit return.) Highlight the Standard Paragraph style, choose Format Character, and then use the menus in order to pick the font name and size you want as the default.

Finally, use the Transfer Save option to save the style sheet as NORMAL.STY, then choose Exit to go back to *Word's* editing screen. *Word* now automatically attaches NORMAL.STY to all your files. And the new standard paragraph will be the default for all text that does not have another style or character formatting applied to it.

Frank Laughlin
Santa Monica, California

PC MAGAZINE
Style sheets are probably the most overlooked feature in *Word*. Yet they are the first place you should look when doing anything related to formatting. As a variation on this idea, let's consider *Word's* default margins. The normal default for left and right margins is 1.25 inches on each side. But for many purposes 1 inch on each side is preferable. In this case, too, the easiest solution is to put your preferred defaults in a style sheet.

> - **SIMULATING DEFAULTS:** Style sheets are perfect ways to work around *Word's* formatting defaults.
>
> - **SIZING UP WORDPERFECT:** Version 5.0 is big, but with some care you can still run it from floppy disks.
>
> - **SEARCH COMMENTS FOR TEXT:** This pair of macros operates on a document so that you can find text strings within its comments.
>
> - **TESTING DATE FIELDS:** dBASE III users must be careful when testing for an empty date field.

Go to Gallery, hit Insert, and create a Division entry using the Standard option for the Variant field. Then change the margins to 1 inch using the Format menu, and save the style sheet.

For the record, there is at least one other way to change the default font in *Word*, though it is not as straightforward as using style sheets. If you use MAKEPRD to convert your printer driver to a text file, you'll find that the file includes font descriptions, each of which starts with

(fn

where *n* represents the font number. To find the font name that corresponds with the number, search for)F. This marker ends the font description and is several screens later. You'll find the font name, labeled FontName, just above the end marker.

Some experimentation with the driver for my Canon LPB-8II showed that *Word* will always take the font labeled)F0 as the default. To change the default from Courier to Swiss (the Canon equivalent of Helvetica), I only had to change the Swiss font number to 2 (or some other number that isn't being used). Then, of course, I'd have to convert the text file back to .PRD format with MAKEPRD.

Not so incidentally, if you choose to experiment with MAKEPRD, it's a good idea to make a copy of the .PRD file first so that you have something to go back to if you don't like the results. MAKEPRD and the .PRD format are fully documented in the *Microsoft Word Printer Information* manual.—*M. David Stone*

SIZING UP WORDPERFECT

The student newspaper at Seattle Pacific University wanted to install *WordPerfect*, Version 5.0, on dual-floppy-disk-drive computers. The installation went fine—until I tried to install the HP LaserJet Plus printer driver. Since newspapers use more fonts than just Courier, the printer driver was too large for the minimal space left on the second program disk. However, there was plenty of room on the first program disk. Unfortunately, to run *WordPerfect* 5.0 on a dual floppy system, the first disk must be replaced with the second one.

I found a way to get around this. Simply install *WordPerfect* as instructed and add a small RAMdisk on the *WordPerfect* program disk as a part of the bootup procedure. I found 32K a safe amount to begin with; however, you may need more, depending on the size and number of printer drivers you have.

Start *WordPerfect* as instructed, press Shift-F1 (Setup), select Location of Auxiliary Files, Printer Files, and type C: to indicate the RAMdisk. Install the printer driver(s) as instructed and exit *WordPerfect* (F7). Copy the printer driver(s) from C:\ to the first program disk and have your AUTOEXEC.BAT file copy those files back to

Power User

```
ECHO OFF
REM *** AUTOEXEC.BAT for WordPerfect 5.0 and 2 Floppy System ***
PATH = C:\;A:\;
CLS
ECHO Copying Printer Drivers to RAMdrive C:
COPY *.PRS C:
CLS
ECHO Please insert a DATA DISK in Drive B:
PAUSE
CLS
ECHO Loading WordPerfect 5.0
B:
A:wp
```

Figure 1: This batch file avoids the space crunch when you install WordPerfect 5.0 on floppy disks.

the RAMdisk during future bootup, as shown in Figure 1.

Adam L. Marin
Seattle, Washington

Imagine you're installing WordPerfect for the first time. You create your work disks, fire it up, and start installing printers. Then you run out of disk space. Discouraging indeed!

The author suggests loading the printer drivers to the RAMdisk from AUTOEXEC.BAT. However, this implies that the WordPerfect disk is bootable, and the system files are on it. There are two good reasons not to make the WordPerfect disk boota-

> **There are two good
> reasons *not* to make
> the *WordPerfect* disk
> bootable.**

ble. First, the system files take a fair chunk of disk space. Second, when you have a floppy-disk–based system, it's safer to always boot from a single write-protected boot disk. It lessens the possibility of a virus attack.

If you create a nonbootable WordPerfect disk, you can give the batch file in Figure 1 any name you like. You could even call it AUTOEXEC.BAT, but you'd have to type AUTOEXEC at the DOS prompt to run it. A better name might be WP5.BAT.
—Neil J. Rubenking

SEARCH COMMENTS FOR TEXT

WordPerfect 5.0 will search for document comment codes, but not for text within comments. Sometimes it's useful to search for text within a comment, especially when a comment has been used as a self-documenting signpost to guide the operation of a macro. The macros SHOW_COM.WPM (Figure 2) and HIDE_COM.WPM (Figure 3) act as a pair. SHOW_COM changes all comments within a document into document text, allowing searches for text within the comments. HIDE_COM changes all comments that were converted into document text back into comments.

To search for text within comments, invoke SHOW_COM.WPM, which searches for document comment codes. When it locates one, it goes into the comment and marks it as a comment with æ (ASCII character 145) at the beginning and Æ (ASCII character 146) at the end. To enter these characters, hold down the Alt key while pressing the number 145 or 146 on the number pad (the numbers on the top row will not work). When you release the Alt key, the character will appear. The macro then exits the comment and converts it into document text. SHOW_COM searches again for document comment codes and repeats the process of marking and converting text until there are no more comment codes.

After running SHOW_COM, search for text as usual. When you finish your search, reverse the process, using HIDE_COM.WPM. It searches for an æ, and when it finds one, moves the cursor one character to the left and starts a block of highlight. It then searches for an Æ character and extends the block to include all the text that formed the comment. HIDE_COM then

converts the blocked text into a comment, deletes the æ and Æ characters, and searches for another æ character. This process of converting and converting continues until no more æ characters remain.

The use of æ and Æ ASCII characters to mark the beginning and end of comments is purely arbitrary. You can use any character or string of characters that's never used in your documents. However, you should note that if a string of characters is substituted, SHOW_COM must be modified to include every character in the string in the block of text to be converted to a comment. HIDE_COM must also be modified so that it deletes every character in the string after converting text from document form to comment form.

I have not shown the steps for creating SHOW_COM.WPM and HIDE_COM.WPM, since creating the macros is an involved process. However, you can create them step by step with WordPerfect's macro editor, using the Ctrl-PgUp key combination to create the {PAUSE}, {ON NOT FOUND}, and {GO} commands.

Jock K. Chung
Washington, D.C.

```
{DISPLAY OFF}{Home}{Home}{Home}{Up}
{LABEL}SEARCH~
{Home}{Search}{Text In/Out}{Search}
{ON NOT FOUND}{GO}END~~
{Text In/Out}æ
~
{Home}{Home}{Down}æ
{Exit}{Text In/Out}Æ
{GO}SEARCH~
{LABEL}END
```

Figure 2: SHOW_COM.WPM turns comments into ordinary text, leaving markers at the start and end.

```
{DISPLAY OFF}{Home}{Home}
{Up}
{LABEL}SEARCH~
{Home}{Search}æ{Search}
{ON NOT FOUND}{GO}END~~
{Left}{Block}
{Search}Æ{Search}
{Text In/Out}æ
{Text In/Out}æ
{Del}{Home}{Home}{Home}{Home}
{Down}{Backspace}
{Exit}
{GO}SEARCH~
{LABEL}END
```

Figure 3: HIDE_COM.WPM checks for markers and turns the included text back into a comment.

Power User

After you've used SHOW.COM, you're in a vulnerable position. If you accidentally delete one of the marker characters, you may find that big chunks of your document disappear into comments when you call HIDE.COM. You should SHOW the comments, perform any searches you want to make, and when you have finished, HIDE the comments again right away.

The text doesn't explain entirely how to substitute text strings such as *BEGIN* and *END* for the single-character markers. Changing SHOW.COM is easy—just replace the single characters with the marker strings. In HIDE.COM, you also replace the single characters, but there's more. Find the {Left} code and replace it with as many {Left}'s as there are characters in the startmarker. Likewise duplicate the {Del} code. Then replace the single {Backspace} with as many {Backspace}'s as there are letters in the endmarker. That does it. Note that a marker like

```
(Enter)**BEGIN**(Enter)
```

would make the comment stand out from the rest of the text.—*Neil J. Rubenking*

TESTING DATE FIELDS

Both dBASE III and III Plus fool your program when they try to evaluate a nuldate field (for example, one in which no entry was made). To see what happens, try entering:

```
nuldate = CTOD("")
? DATE() = nuldate
```

or

```
nuldate = CTOD("")
? DATE() <> nuldate
```

from the dot prompt. Both return .F.

Something is clearly wrong if nuldate is neither equal to nor different from today's date. This means that a program testing whether a date has been entered is likely to be misled and abort in the wrong direction.

The solution presents another oddity. From the dot prompt enter either:

```
? DATE() = nuldate
```

or this statement

```
? nuldate = DATE()
```

Both will return a 0. Illogical as this result is, at least it's consistent: any date subtraction involving a nuldate will yield 0 as its result. So this is a reliable way to test whether a real date has been entered.
Tom Lawford
Washington, D.C.

Mr. Lawford has identified a potentially serious glitch in the dBASE III program and has produced a simple work-around to this problem. Fortunately, the problem does not exist in either FoxBase or Clipper, and it has been fixed in dBASE IV.

A technical service representative at

> To change
> SHOW.COM, replace
> single characters with
> marker strings.

Ashton-Tate proved very helpful. He suggested converting the date to a character string first and then testing if the character string is empty (rather than comparing the nuldate as a date). For example,

```
? DTOC(nul)>" "
```

This returns .F., and works in all dBASE language programs. In addition, if you wish to require that a date be entered in a data entry situation, he suggested adding a RANGE clause as part of the GET statement.—*Brad Stark*

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Fig. 1

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CONSTRUCTOR METHODS CAN CAUSE PROBLEMS

In Turbo Pascal 5.5 any object that contains virtual methods must have a constructor, which initializes the VMT field of the calling instance to point to the object's Virtual Method Table. Frequently the constructor will perform other useful functions, so there may be occasion to call a constructor without this VMT initialization. It is important to note, however, that unless you specifically prevent it, every call to a constructor will reinitialize the VMT field.

The program in Figure 1 illustrates a problem that can happen when a VMT gets initialized by mistake. The constructor Child .Init calls the method InitializeParent to allow the ancestor object to perform any necessary initialization. InitializeParent accomplishes its task by calling the Parent's

---

- **EDITOR'S NOTE:** Let's hear from readers working with object-oriented programming languages and with OS/2.

- **CONSTRUCTOR METHODS CAN CAUSE PROBLEMS:** When an ordinary method of a Turbo Pascal object calls a constructor method, the results can be unpleasant.

- **BRINGING RANDOMNESS TO ORDERED SETS:** Here is a clever way to randomly reorder an ordered set, an example of which is sorting a deck of cards.

---

constructor Init. When this program runs, you may be surprised to find that the call to Child.Init.Message produces the message "Parent Message."

In this example, the call to Child.Init sets the VMT field of Child.Init to point to the VMT for Child objects. Then it calls InitializeParent, which in turn calls Parent's Init method. The unqualified call to the constructor for Parent causes the VMT field of Child.Init to point to the VMT for Parent. From then on, all virtual calls from the instance Child.Init will use the methods for Parent, which of course is not what was intended.

To prevent the VMT field of Child.Init from being overwritten, you can use a qualified method call within the method Initialize-Parent, as follows:

```
PROCEDURE Parent.InitializeParent;
  BEGIN
    Parent.Init;
  END;
```

As discussed on page 103 of the *Turbo Pascal 5.5 Object-Oriented Programming Guide*, this type of call causes the compiler not to initialize the VMT field. Typically, a call to an ancestor's constructor is done directly within the descendant's constructor, both of which are usually called "Init." This forces you to use a qualified constructor call and thus prevents the problem behavior from occurring.

The best way to avoid problems like the one illustrated is to make sure that every call to a constructor from within a method uses a qualified method call. It is unlikely that you would want a method that is *not* a constructor to initialize the VMT field. Since constructors are always static, use of the qualified call will not affect which method is actually executed at runtime—it will only prevent the unwanted VMT field initialization.

Richard W. Prescott
Madison, Wisconsin

PC MAGAZINE If the Child object had any static methods, the program in Figure 1 would make the instance variable ChildInst into a strange sort of hybrid. All calls to static methods would work correctly, while calls to virtual methods would call the Parent type's method. There is no question about it, you do *not* want to allow a nonconstructor method to make any calls that initialize an object's VMT. Probably, the compiler itself should forbid this, but it doesn't.

One way to prevent the problem is to qualify any calls to the constructor as described above. By putting the object name and a period in front of the constructor's name, you are telling the compiler not to generate code that initializes the VMT of the calling instance.

There is a different approach to this problem that I would recommend. Don't ever call a constructor from within another method. If necessary, you should separate the code that initializes the object's data fields into a separate method and have the constructor call that method. In the exam-

Languages

CONSTRUC.PAS   COMPLETE LISTING

```pascal
PROGRAM construc;

TYPE
  Parent = OBJECT
    PROCEDURE InitializeParent;
    PROCEDURE Message; Virtual;
  END;

  Child = OBJECT(Parent)
    PROCEDURE Message; Virtual;
  END;

CONSTRUCTOR Parent.Init;
BEGIN END;

PROCEDURE Parent.InitializeParent
BEGIN
  Init; {- Calls Parent.Init -}
END;

PROCEDURE Parent.Message;
BEGIN WriteLn('Parent Message');
END;

CONSTRUCTOR Child.Init;
BEGIN InitializeParent; END;

PROCEDURE Child.Message;
BEGIN WriteLn('Child Message');
END;

VAR
  ChildInst: Child;

BEGIN
  ChildInst.Init;
  ChildInst.Message;
END.
```

Figure 1: Illustrated here is the danger of calling a constructor from a nonconstructor method in Turbo Pascal 5.5.

ple given here, the constructor Init would call the method InitializeParent, instead of the other way around.—*Neil J. Rubenking*

BRINGING RANDOMNESS TO ORDERED SETS

There are many sorting routines that take an arbitrary collection of elements and rearrange them into an ordered set. However, I need to take an ordered set and randomly scramble it, much like shuffling a deck of cards. Unfortunately, I cannot just call a random number function to generate my elements randomly. The reason for this (continuing the card-shuffling analogy) is that I might end up with the equivalent of, say, two jacks of hearts but no three of diamonds. Altering this scheme to avoid generating the same element twice is objectionable because it requires either too much programming overhead or too many calls to the random function, which slows down the routine considerably.

Fortunately, I was able to develop a scrambling routine that uses the "quick

SHUFFLE.C   COMPLETE LISTING

```c
/* SHUFFLE.C - rearranges a given set of specific objects - in this
   case a deck of playing cards - into random order. This
   illustrates the proper use of the subroutine shuffle().
*/

#include <stdio.h>
#include <stdlib.h>
#include <time.h>

#define N 52      // number of objects in the set - 52 for a deck of cards
#define NMAX 100  /* maximum number that shuffle() can rearrange;
                     must be greater than or equal to N */

typedef struct {
                 int word1;
                 int word2;
               } dword;  // structure needed by shuffle()

char *suit[4] = {"spades", "hearts", "clubs", "diamonds"};
char *value[13] = {"ace", "two", "three", "four", "five", "six", "seven",
                   "eight", "nine", "ten", "jack", "queen", "king"};

void shuffle(int, int *, unsigned int);  // function prototypes
int compare(dword *, dword *);

main()
{
  int i;
  int a[N];            // one-dimensional array to be shuffled
  unsigned int see;    // arbitrary integer to seed rand()
  long tval;

  seed = (unsigned int) (time(&tval) % 65536); // random seed based
  shuffle(N, a, seed);                         // on time
  for(i=0; i<N; i++)
    printf("\n%s of %s", value[a[i] % 13], suit[a[i]/13]);
}

/* shuffle() - This is the heart of the program. It assigns a one-
   dimensional array of integers, whose beginning address
   is base, all the values from 0 to N-1 in random order.
   The seed is arbitrary and is used only to have repeated
   cells to shuffle() return different sequences.
*/

void shuffle(int n, int *base, unsigned int seed)
{
  int i;
  dword RandomIndex[NMAX]; /* dword structure randomizing vehicle.
                             NMAX is the maximum possible number of
                             objects in the set, and must be
                             initialized by the user. */

  srand(seed);             // initialize rand()
  for(i=0; i<n; i++)       // initialize RandomIndex
    {
      RandomIndex[i].word1 = rand(); /* first part is a random number
      RandomIndex[i].word2 = i;      // second starts as e */
    }

  qsort(RandomIndex, n, length, compare); /* sort first part only,
                                             but "drag" second parts
                                             along */

  for(i=0; i<n; i++)
    *base+i = RandomIndex[i].word2;  /* assign array to
                                        newly randomized
                                        second parts */
}

/* compare() - routine needed by qsort() to compare the values of
   dwords according to their first parts only */

compare(dword *elem1, dword *elem2)
{
  return(elem1->word1 - elem2->word1);
}
```

Figure 2: This program demonstrates the use of the shuffle routine to shuffle a deck of cards. The routine is independent of the program and can be used to randomly reorder any ordered set.

Languages

sort" algorithm to solve my problem. Figure 2 provides the C source code for my routine, called shuffle(), as well as a sample card-shuffling program that utilizes it. The most important thing to observe is that it calls the random number generator, rand(), only once for every element.

Shuffle() takes three arguments and generates an array of N integers that contains all values from 0 to N-1, arranged randomly. To use the function from within a program, it must be declared as follows:

```
void shuffle(int N, int *base,
    unsigned int seed);
```

where N is the number of elements in the collection, *base is a pointer to the start of the array, and seed resets rand() with a new initial value.

The function basically works by generating an internal array of N elements, where each element is a structure consisting of two parts. The first is a random number, and the second is one of the original inte-

gers 0 through N-1, where the values increase in consecutive order.

I use qsort(), the standard C library version of the quick sort algorithm, to arrange each structure according to its first part. The

second element is taken along in the process. The array at base is then assigned to the second parts of the structured array, which now contains the integers 0 through N-1 in random order.

Shuffle.C illustrates the shuffle routine. After the program is compiled, typing "shuffle" at the command line will produce a list of 52 playing cards in random order.

Jeffrey J. Hamilton
Jessup, Maryland

Sooner or later, every programmer faces the need to create a randomly ordered set of one kind or another. Mr. Hamilton's idea of creating one by way of the qsort() function is certainly clever.

Beginning programmers should take a close look at the code, as it provides a clear lesson in using qsort(). The example program that uses the shuffle routine should also be studied carefully, as it provides a handy lesson for those of you trying to write your first blackjack game. The algorithm can be extended any number of ways to accommodate many games requiring a randomizing process.—*Tony Rizzo*

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Tutor

HOW DEVICE DRIVERS WORK

Can you tell me something about what device drivers are, and how they are loaded and initialized by DOS?

Harold S. Harrington
Jerome, Arizona

PC Device drivers—program modules that insulate software from hardware by providing a low- to medium-level communications interface between the two—are loaded into low memory directly above the operating system's file-control blocks and disk buffers. Device drivers become permanently resident in memory, acting like extensions of the operating system itself.

DOS positions the device drivers in memory during start-up and chains them together to form a linked list. When a call is made to open a device, DOS begins with the first device driver in the chain and searches until it finds a character driver of the same name or a block driver with the designated logical drive letter. The NUL driver is always first in the chain, followed by the installable device drivers loaded from CONFIG.SYS. The internal device drivers that DOS loads by default appear at the end of the chain.

It's important to note that a device driver's location in memory doesn't necessarily correspond to its position in the chain. Installable device drivers are loaded last, after DOS's internal drivers, but DOS tweaks the links in the chain so that installable drivers come earlier in the search order than internal drivers.

One benefit of this is that any of DOS's internal character device drivers, with the exception of NUL, can be replaced by an installable driver of the same name. One familiar device driver that does this is ANSI.SYS. When installed, ANSI.SYS replaces CON, the default system console driver. All data streams that are directed to standard input or standard output are routed through ANSI.SYS, even though the original CON driver remains in memory. Unlike character drivers, however, block

■ HOW DEVICE DRIVERS WORK: Understand how DOS loads and initializes device drivers.

drivers cannot be replaced. Instead, DOS assigns logical drive letters to block device drivers loaded from CONFIG.SYS on a first-come, first-served basis, with its own block driver taking precedence over all others.

At start-up, DOS loads the NUL, CON, AUX, PRN, and CLOCK$ device drivers, followed by a single block driver

driver that provides support for mass storage devices. After these and additional internal device drivers that support the COM and LPT ports are installed, DOS turns to the CONFIG.SYS file for a list of installable device drivers to be loaded from disk. Drivers are processed and placed in memory in the order in which they appear in CONFIG.SYS.

Immediately after a driver is loaded, DOS calls the driver's Init function to verify that the device it is associated with is present and operational and to give the driver the opportunity to perform any needed initializations. The driver, in turn, notifies DOS of the address of the next higher block of available memory. DOS

A DEVICE-DRIVER CHAIN

Address	Logical name*	Number of units**	Comments
027A:0048	NUL	—	DOS NUL device driver
206F:0000	CON	—	ANSI.SYS
103F:0000	—	1	VDISK.SYS
09C9:0000	$$$SCACHE	—	IBMCACHE.SYS
0070:016E	CON	—	DOS console driver
0070:0180	AUX	—	DOS serial port driver
0070:0192	PRN	—	DOS printer driver
0070:01A4	CLOCK$	—	DOS clock driver
0070:01B6	—	6	Drives A: thru F:
0070:01CA	COM1	—	Additional system driver
0070:01DC	LPT1	—	Additional system driver
0070:01EE	LPT2	—	Additional system driver
0070:0200	LPT3	—	Additional system driver
0070:0212	COM2	—	Additional system driver
0070:0224	COM3	—	Additional system driver
0070:0236	COM4	—	Additional system driver

* Character device drivers only.
** Block device drivers only.

Figure 1: A device-driver chain as it appears on an IBM PS/2 Model 70 running DOS 3.3 with a 120MB hard disk divided into four logical units. The first device driver in the chain is always the NUL driver supplied by DOS, positioned in such a way that it can't be superseded by subsequently loaded device drivers. Next come the installable device drivers loaded from the CONFIG.SYS file. Last come the remaining system drivers DOS 3.3 installs on a machine: COMx and LPTx, which support up to three parallel ports and four serial ports and permit application programs to open them by name.

Tutor

uses this address as the physical location of the next device driver it loads.

As the device drivers are loaded, DOS forms a linked list by filling each device header with the segment:offset address of the next driver in the chain. The last driver in the chain is identified by the double-word value −1 (4 consecutive bytes equal to FFh).

Figure 1 illustrates how DOS 3.3 arranges the chain of device drivers in an IBM PS/2 Model 70 with a 120MB hard disk partitioned into four logical drives. Three drivers are loaded from the CONFIG.SYS file: IBMCACHE.SYS, VDISK.SYS, and ANSI.SYS, in that order. Note that the drivers are listed in the order they appear in the chain, *not* in the order in which they appear in memory. The physical address of each driver is indicated by the segment:offset address in the leftmost column of the table.

The first driver in the chain, predictably, is NUL. NUL is followed by ANSI.SYS, then by VDISK.SYS and IBMCACHE.SYS. You should note that IBMCACHE.SYS, the first driver that appears opposite a DEVICE statement in CONFIG.SYS, resides lower in memory than VDISK.SYS and ANSI.SYS, but higher in memory than any of DOS's internal device drivers. Also note that VDISK.SYS is capable of handling only one logical unit, while the block driver provided by DOS provides support for six disk drives: two floppies plus the four hard disk partitions. In this case, DOS assigns the drive letters A: through F: to its own block device driver and the drive letter G: to VDISK.SYS.

You can trace the chain of device drivers in your own system by using DEBUG to inspect the contents of the device headers. The structure of the DOS device header is shown in Figure 2. The first two words designate the segment:offset address of the next driver in the chain. The word at offset 04h contains a series of bit flags that provide information about the nature of the device driver. A 1 in bit 15 identifies a character driver, while a 0 identifies a block device driver. The words at offsets 06h and 08h contain the offset addresses of the device driver's strategy and interrupt routines, respectively. The 8 bytes beginning at offset 0Ah contain the logical name of the driver if it is of the

character type or the number of units it supports if it is of the block type.

Once you find one device driver in memory, finding the next one is easy. The key is locating the first one. There are two ways to find the NUL driver. The first is to search low memory for the first occurrence of the character string "NUL", then subtract 10 bytes from its address to locate the beginning of the device header.

But the better way to locate NUL is to call on the undocumented DOS function 52h, which returns a pointer to a list of internal DOS parameters in ES:BX. The list, whose length varies between 23 and 34 bytes, depending on the version of DOS, is immediately followed by the NUL device driver.

To inspect the device chain, start DEBUG and type

```
A
MOV    AH,52
INT    21
RET
```

Press Enter once by itself to terminate the assembly process, then type G 0104 and record the values of ES and BX on return.

Then type D SSSS:XXXX, substituting the segment value returned in ES for SSSS and the offset address returned in BX for XXXX. Afterwards, you should see the characters "NUL" displayed somewhere on the right side of the screen. Count back 10 bytes from the "N" in "NUL" to find the beginning of the NUL device header and the address of the next driver in memory. By dumping the contents of memory at the addresses indicated in successive device headers, you can trace the chain of device drivers through memory and see exactly how DOS stacks them up.—*Jeff Prosise*

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THE STRUCTURE OF A DOS DEVICE HEADER

00h	Offset address of next driver
02h	Segment address of next driver
04h	Device attribute flags
06h	Offset address of strategy routine
08h	Offset address of interrupt routine
0Ah	Logical name (8 bytes) for a character device driver, or the number of units (1 byte) supported by a block device driver

Figure 2: The structure of a DOS device header. The first two words designate the segment:offset address of the next driver in the chain (the value −1 indicates the driver is the last in the chain). The word at offset 04h contains a series of bit flags that provide information about the nature of the device driver. The words at offsets 06h and 08h contain the offset addresses of the device driver's strategy and interrupt routines, respectively. The 8 bytes beginning at offset 0Ah contain the logical name of the driver if it is of the character type, or the number of units it supports if it is of the block type.

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THE ULTIMATE DESKTOP REFERENCE

by
Frank J. Derfler, Jr.

Connectivity Clinic

SINGLE-USER SOFTWARE ON A LAN

We have two PC-XT's networked together using IBM PC LAN software. Some word processing software came with the computers, but I don't know where to look for other multiuser or networkable applications—particularly accounting software. The package we used before was *Dac Easy*, but unfortunately, it isn't designed for use on a network. Can you suggest a source for this type of software?

Nancy Ethier
Plattsburgh, New York

PC MAGAZINE None of the application programs you use on a network need be network versions—that is, multiuser. If you like *Dac Easy* and you don't need to give more than one person access to the same files at the same time, then use *Dac Easy*. Put the software on the hard disk of the machine acting as a file server and let only one person use it at a time.

On a small network, it is relatively easy to control how and when the software is used. If you regulate access to the software through human management, you can load any single-user application on your network and run it one-user-at-a-time.

If you expect your network to grow and may need to allow several users to access your accounting software simultaneously, our review of accounting software packages in the September 26, 1989 issue will help you decide which package will meet your needs.

REDUCING MEMORY LOAD

Your March 28 review of LAN software describes how some networks reduce the amount of RAM they require by downloading drivers and interface software to the network adapter cards. We have token-ring wiring installed, and our users need every byte of RAM they can get. Does anyone sell token-ring cards that download the *NetWare* drivers to on-board RAM?

John R. McGovern
Daytona Beach, Florida

- ■ **SINGLE-USER SOFTWARE ON A LAN:** Regulating software access lets you use your current software.

- ■ **REDUCING MEMORY LOAD:** Downloading NetWare drivers to network adapter cards.

- ■ **BRIDGES, ROUTERS, AND BROUTERS:** Learn how networks and systems can be connected.

PC MAGAZINE Getting the *NetWare* drivers out of the DOS 640K working space is the goal of many LAN managers. However, when software utilities throw programs into the space between 640K and 1 megabyte, they always have the potential for stepping on memory used by video adapters or as I/O address ports by communications boards of various kinds. Downloading drivers to an adapter card is a dandy way to handle the problem.

Madge Networks markets both Micro Channel and AT-bus token-ring adapters with a program that moves *NetWare*'s IPX (Internet Packet Exchange) to the adapter. You save only about 20K of RAM because IPX isn't very big, but since token-ring boards are otherwise pretty much alike, this feature could decide whose boards you buy. Contact Madge Networks at (703) 982-0638 for information on its IPX/SPX LAN Support Program. The people at Madge tell us that these boards will be more valuable with *NetWare 386* because of its bigger driver stack.

BRIDGES, ROUTERS, AND BROUTERS

I recently sat through a presentation where various connectivity terms were casually tossed around. I think I understand bridges and gateways, but routers and brouters have thrown me.

Jessie McWilliams
Simi Valley, California

PC MAGAZINE Bridges, routers, and brouters are great buzzwords, but they cause a lot of confusion. Here are some things you should understand about them.

There are five ways to hook one network to another or to expand a network over a wider area. The names of the different devices you can use are bridge, MAC-layer bridge, router, brouter, and gateway. These devices are illustrated in Figure 1.

Think of a *bridge* as a two-way electrical repeater. It extends the cable and repeats every packet. The physical cable, the electrical signaling, and media access control protocols (usually CSMA) are the same on both sides of the bridge.

A *media access control (MAC) bridge* can connect networks using different kinds of cabling. This technique relies on a common method of formatting and addressing a packet, such as the IEEE 802.X MAC portion descriptions, so that it can move packets between dissimilar systems. For example, it can link twisted-pair Ethernet, fiber-optic cable, and coaxial cable Ethernet networks.

Routers start out passing all packets to both sides of the bridge, but their on-board processors quickly "learn" where addresses are. Thus, they are able to transfer only packets that need to be transmitted to the other network segment, reducing traffic on both sides of the bridge. If the network has multiple connections providing more than one route to move a packet to an addressee, the routers exchange traffic information to determine the best path.

Brouters are routers that can link dissimilar networks. Like a MAC-layer bridge, they use some common protocol, perhaps the IP portion of the TCP/IP protocols, to direct traffic between dissimilar transmission systems.

Gateways link networks to very dissim-

Connectivity Clinic

ilar systems. Each gateway is typically designed for a specific application, like a network of PCs talking to an IBM SNA computer.

NETWORK YOUR QUESTIONS

Connectivity Clinic gives you practical solutions to networking problems of all types. We'll pay $50 or more for any tips we print, *plus an extra $25 if you submit your letter on a disk.* If you do, please include a printed copy. We'll gladly answer your questions at no charge, but we cannot answer letters personally. Mail contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). You may also contact Frank J. Derfler, Jr., via MCI Mail (use Derfler's box named CONNECTIVITY CLINIC). ∎

FIVE WAYS TO CONNECT SYSTEMS

SYSTEM 1 — CONNECTION — SYSTEM 2

All packets — 1. Bridge
Coaxial Ethernet

All packets — 2. MAC layer bridge
Coaxial Ethernet — Twisted-pair Ethernet — Wiring hub

Only destination packets — 3. Router
Coaxial Ethernet — Coaxial Ethernet

Only destination packets — 4. Brouter
Coaxial Ethernet — Fiber-optic cable — Wiring hub

Translated messages — Translated messages — 5. Gateway PC
Coaxial Ethernet — RS-232 SNA link — SNA mainframe

Figure 1: Bridges of all kinds pass all packets in both directions. MAC-layer bridges can link dissimilar cabling systems. Routers and brouters pass packets from one network to another only if they have a destination address on the other network. Gateways translate between very different systems such as PC-based LANs and IBM mainframes using the SNA communications scheme.

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- 101-key enhanced keyboard
- 145-watt power supply

Monitor optional.

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64767

316s Monitor and Hard Drive Options

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80MB	64764	64844	$2539
(15ms)	$2229	$2679	$2749
110MB	64765	64843	64762
(15ms)	$2539	$2979	$2949

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- Dual diskette drive controller
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- Six available expansion slots
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- 40MB IDE hard drive
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- 101-key enhanced keyboard
- INTEGRATOR software

$2449
64790

220 Monitor and Hard Drive Options

	MVGA	CGA	CVGA
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	$2449	$2849	$2949
(29ms)			
80MB	64791	64795	64799
(15ms)	$2679	$3079	$3159
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- New Spinnaker™ Eight-in-One™ integrated software
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- Computer paper and ten blank diskettes

Color monitor optional

Career Starter Kit Options

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- Computer paper and ten blank diskettes

Color monitor optional.

Professional Starter Kit Options

	MGA	CGA	CVGA
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■ SUPERCHARGED PORTABLES

As their name implies, portables are traveling fast—along an upward path of greater speed and power. PC Labs brings you up to date on 11 80386-based machines running at speeds of 20 MHz and faster, including IBM's Model P70, Compaq's Portable 386, and the Toshiba T5200. It wasn't long ago that this type of power was extraordinary in the desktop arena. Now you can take it on the road to make impressive presentations and keep up with the office workload at the same time.

■ PAPER-WHITE MONITORS FOR DTP AND CAD

Desktop publishing and computer-aided design are flooded with display and adapter card options. To reduce the confusion, we test 13 monitors that produce dual-page displays with readable type and that come bundled with their own video adapter cards to guarantee compatibility.

■ MEMORY BOARDS

286 owners, do you ever feel like the benefits of multitasking are out of your reach? PC Magazine can help you take advantage of today's multitasking environments with detailed testing and reviews of ten LIM EMS 4.0 memory expansion boards. These boards can carry at least 8MB each and are optimized to work with environments like Quarterdeck's *DESQview* and Microsoft *Windows*. In addition, they all support extended memory for OS/2, so you'll never waste a bit of RAM.

■ THE GREAT KEYBOARD DEBATE

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After Hours

Products for the Leisure Side of Personal Computing

Vette!, from Spectrum Holobyte, Puts You In a Fantasy Corvette

GAMES
by Bill O'Brien

Spectrum Holobyte has combined the competitive thrill of *Pole Position*, the driving challenge of *Test Drive*, and the door-slamming speed of a NASCAR Winston Cup race. The result is *Vette!: The Street Race Simulation Through San Francisco*, a $49.95 street-racing program that brings out the speed demon in any car enthusiast.

Vette! offers the PC driver a wide choice of classic Corvette models. For the timid, there's a stock Vette, with its 245-bhp 350 CID engine. Driving the pathetic, four-speed automatic, with its lock-up torque converter, you'll be propelled down the road at a miserly 154 miles per hour, max.

If you've packed your glycerin tablets, you might try the ZR1. Its 380-bhp 349 CID engine will unwind around the six-speed transmission to the tune of 7,200 rpm for a top speed of 180 mph. The ability to go from zero to 60 in 4.2 seconds makes you at least competitive.

Just above the ZR1 is a Callaway "Twin Turbo," conceived by the Callaway crew in the otherwise staid state of Connecticut. Its twin air pumps add 2 bhp to the ZR1 spec and bump the top speed to 191 mph.

Of course, if you live by the motto "excess is best," you will insist upon the "Sledgehammer." Also a product of the mad geniuses at Callaway, the twin turbos in this monster are more than just hair drivers. Pumping 898 bhp out of its 350 CID engine, this hog rockets along at a top speed of 254 mph.

Just so you don't get bored, *Vette!* lets you vie for bragging rights against a tame (computer-driven) Porsche 928S/4, a flashy Countach (pronounced "Coon-tosh"), or either of a dashing duo of Ferraris.

Which racetracks do you abuse with all this power? None. *Vette!* is a *street*-racing simulator. It inflicts you and your lead foot on the otherwise placid streets of San Francisco. Armed with a map of the city and its environs, you can wreak havoc along any of four possible courses. You howl through busy streets, along crowded highways, and over city bridges. On these courses, skill is as valuable as speed.

- **GAMES**
  Gauntlet II moves out of the arcade and onto your PC.

- **SCIENCE**
  Add-on device turns your PC into a Geiger counter.

- **TRAVEL**
  Streets on a Disk prints maps and travel directions.

STOCK | ZR1 | TWIN TURBO | SLEDGEHAMMER

Among the Corvette models offered in *Vette!* is the Sledgehammer, a no-compromise street racing monster.

Vette!'s excellent graphics include realistic views of downtown San Francisco. You must avoid other cars as well as pedestrians.

Vette! has considerable carnage potential. As you go barreling down city streets or across the Bay or Golden Gate bridges, unwitting pedestrians can plod into your path. Buses, trucks, and slow-moving cars may make you plead for divine intervention as you zig, zag, brake, and swerve around them. On the highways, you'll need to contend with guardrails and tight-radius turns as well as other vehicles.

Not unsympathetic to your plight, Spectrum gives you a choice of three driving modes: Trainee, Rookie, and Pro. Trainees are immune to the damage caused by hitting solid objects, and your only real worry is staying out of the bay. Collisions do slow your car down, however.

As a Rookie you notice that collisions damage your vehicle in direct proportion to your speed at impact. You are also subject to the attentions of the local police (if they can catch you). The men in blue are more than

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And more choices. Step on the turf of seven familiar big league ballparks. Gaze out onto the field from five network TV field perspectives. Create your very own dynasty with the team editor.

HardBall II is in a league by itself. And fortunately for our grandchildren, we get to play it in its prime.

How to order: Visit your favorite retailer or call 800-245-7744.

ACCOLADE™
The best in entertainment software.™

Actual game screens from IBM PC EGA version of the game. Other versions may vary.

After Hours

Vette!
CONTINUED

happy to write you up a ticket for any of a plethora of traffic violations.

If you're really good and your family name is Waltrip or Petty, you might try the Pro mode. Be warned, however; you will watch your car disintegrate

can't keep up with itself. I spent a good portion of a bridge crossing riding on a solid sea of blue when the graphics manager forgot to switch the bridge back on after a collision. On another ride through hell I was caught beneath the wheels of a tractor trailer as it ran back and forth over my Sledgehammer until I switched the computer off.

But these are minor, infrequent problems (I logged 46 hours on the game and fell victim to

Vette! depicts the Golden Gate Bridge, along with a number of other familiar San Francisco landmarks.

around you as you forgo better judgment and bounce off of other motorists while trying to take a 90-degree switchback at 252 mph.

Vette! consistently satisfies with its complexity and attention to detail. Spectrum gives you a simulated 3-D environment to impress on you that you are dealing with solid objects. No matter which car you select, you can run it with either an automatic or a manual transmission.

A forward view through the windshield is the default, but you can toggle between left and right mirrors and maintain a rearview mirror display (drive too slowly and your car will be rearended by oncoming traffic). Add to this a helicopter view (with or without dash display), as well as variable elevation for your point of view, and you might begin to understand the amount of graphics manipulation going on behind the scenes.

This graphic environment is so complex that it sometimes

only two such incidents). They are negligible when weighed against the full impact of Vette!

Having considered all of the possibilities thus far, imagine Vette! as a two-player game. No, both drivers don't need to be hunched over a single keyboard. All you'll need is a friend with a serial port or a modem, and you can battle each other while passing angry glares over your monitors or even across long distances.

If you like cars and love competition, Vette! is a game you must buy.

List Price: Vette!: The Street Race Simulation Through San Francisco, $49.95. **Requires:** For CGA version: 7-MHz or faster PC or compatible; CGA or MGA graphics; DOS 2.0 or later. For EGA version: AT or compatible; 640K RAM, EGA graphics with 256K video RAM, DOS 2.0 or later. Spectrum Holobyte, 2061 Challenger Dr., Alameda, CA 94501; (415) 522-3584.
CIRCLE 429 ON READER SERVICE CARD

Gauntlet II Moves the Dungeon from The Arcade To Your Living Room

Here's relief for fans with fingers mangled by chucking quarter after quarter into the arcade game Gauntlet. Now, for about 160 quarters, you can own Mindscape's Gauntlet II and play it for free in your own living room.

Thor, Thyra, Questor, and Merlin are all there, fighting their way through more than 100 new mazes—make that dark dungeons—in a futile attempt to reach their final reward.

As in the arcade version, you pick a character to represent you. Whether you choose Thor the Warrior, Merlin the Wizard, Thyra the Valkyrie, or Questor the Elf will depend on what characteristics you most value. Thor, for example, has a tough skin that deflects 20 percent of his injuries, but he's none too sharp in the magic powers department. Merlin, as might be expected, is tops with magic but has thin skin. Each character starts with unlimited shooting power and 2,000 health points. Health diminishes with time and combat and can be replenished

with food and cider hidden in the dungeons.

Your point of view as you play Gauntlet II is a semi-3-D perspective of the dungeons, seen from above. The icons in the EGA/VGA version look more or less like what they are supposed to be: ghosts, grunts, demons, lobbers, sorcerers, death, acid puddles, and other equally vexing obstacles. The graphics aren't stunning—other than on the box and title screen—but they are better than what we were getting a year or two ago from transplanted arcade games.

Tandy players of Gauntlet II can enjoy enhanced sound (in machines that support it), while IBM players are stuck with muffled rumbles. In the version I played, there's a problem when both a joystick and a mouse are connected to the computer. Mindscape promises to fix this quickly, and in the meantime you can disconnect the mouse.

The best thing about Gauntlet II is that you can play it with your friends. Up to four players can roam the dungeons at the same time, helping one another fend off grunts and avoiding "It," although the keyboard does get a bit crowded. Ask a few friends over, open the box, and once again do battle.

List Price: Gauntlet II, $39.95. **Requires:** 512K RAM, DOS 2.1 or later, color graphics. Mindscape Inc., 3444 Dundee Rd., Northbrook, IL 60062; (312) 480-1948.
CIRCLE 608 ON READER SERVICE CARD

The graphics in Gauntlet II are better than the usual transplanted arcade fare, but they aren't state of the art.

After Hours

Radiation Sensor Helps Your PC Catch Some Rays

Does exposure to alpha radiation have you worried? Gamma rays got you down? If so, check out the RM-60 Micro-Roentgen Radiation Monitor from Aware Electronics. More than just a toy or a tool for the curious, the RM-60 lets you use your PC to monitor your surroundings for life-threatening radiation, affording you the peace of mind that can come only from having your own Geiger counter.

The RM-60 is made up partly of hardware and partly of software. The hardware—an unobtrusive plastic box about the size of a pocket modem— contains a sensitive, calibrated Geiger tube similar to those in industrial radiation monitors. A cable running from the box plugs directly into your PC's parallel or serial port.

The software captures raw data transmitted from the radiation monitor and displays it in the form of a scrolling bar chart, accurately reflecting levels of ionizing radiation recorded for periods of days, weeks, or even months.

The RM-60 detects all three types of ionizing radiation emitted by nuclear materials: alpha, beta, and gamma. It can also detect X rays, and, with the aid of a forced-air filtering system, low levels of radon gas (as little as 1 picocurie per liter). The manual that comes with the RM-60 contains a helpful discussion of common sources of radiation in the home, the units of measure, and what to do when the measured dose exceeds EPA-recommended levels.

Plug in the radiation monitor and install the software, and almost immediately you'll get a reading on the background radiation in your home or office. The software samples the environment continuously and averages the radiation levels in microroentgens per hour over the length of time you specify (a typical interval is 5 to 10 minutes). If the most recent reading exceeds a predetermined level (by default, 27 microroentgens per hour), the software warns you by sounding an alarm.

There are as many different ways to use the RM-60 as there are types of radiation it will measure. Run in the foreground, it will graphically display running totals of ionizing radiation levels as they are read. Run as a TSR, it will quietly gather radia-

This RM-60 bar chart displays ionizing radiation levels recorded over a period of 30 minutes at 1-minute intervals. You can specify other intervals if you desire.
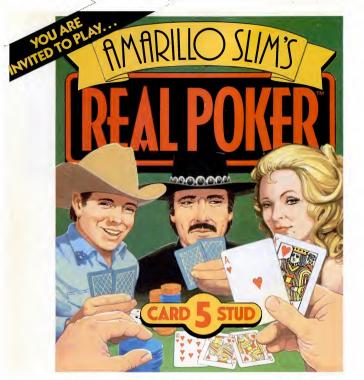
tion data in the background while you go about business as usual. The software warns you if there is cause for alarm. Data captured and stored to the hard disk can be reviewed at your convenience.

To get you started, the RM-60 comes with a sample radiation data file generated from background radiation at a site in southeastern Pennsylvania. As a test, I set it up and measured the levels of background radiation in my California apartment.

The result: an average of 10.6 microroentgens per hour over a period of 30 minutes, a reasonable figure inasmuch as typical levels of background radiation in this country range from about 5 to 25 microroentgens per hour, depending on where you live and what type of dwelling you live in. The RM-60 is capable of measuring levels as low as 1 microroentgen per hour and as high as 30,000.

You'll find this product particularly useful in environments where nuclear materials are handled—in nuclear plants and medical laboratories, for example. You'll also find application for it in the home if you're simply curious about naturally occurring levels of radiation in building materials, soil, food, or beverages. In addition, the RM-60 is any camping store. Most lantern mantles contain quantities of thorium salt, a highly radioactive material that occurs in nature. Readings will soar to levels exceeding 500 microroentgens per hour, a clear indicator that this common household item shouldn't be treated lightly.

Among PC hardware and software products, the RM-60 is unique in many respects. Its most notable distinction may be that in the very worst case—in the event of nuclear attack or nuclear mishap—it is the *one* product you won't want to be without.

List Price: RM-60 Micro-Roentgen Radiation Monitor, $97.50. Requires: Parallel or serial port, DOS 2.0 or later, 256K RAM, graphics adapter. Aware Electronics, P.O. Box 4299, Wilmington, DE 19807; (302) 655-3800.

CIRCLE 429 ON READER SERVICE CARD

Streets on a Disk Gets You from Here to There

"Dear, didn't the Smiths move to Grant Street? Have you any idea where that is and what the best driving route is?" Sounds like a question that your PC should be able to handle. Personal computers are supposed to be ideal for crunching data, after all, and street and address maps represent gobs of data.

Traditionally, however, coping with such data required a mainframe or at least a minicomputer. But advances in PC technology and a remarkable program called *Streets on a Disk* from Klynas Engineering have placed city streets within reach of a well-equipped PC.

The basic program reads map files and displays them on a graphics adapter (CGA, EGA, or Hercules; VGA in EGA emulation works fine). You can display a map on a large scale—say, all of Manhattan. Or you can zoom in on an area of a few blocks. You can search for an area by street name, full address,

CONTINUES

THE BEST COMPUTER POKER GAME AVAILABLE

While games come and go, skill card games remain a favorite form of entertainment. The card game of choice in the world today is poker, and of course, it is my personal favorite. Our version is the best computer poker game available today. It is a great way to rustle up a quick table. Let it become your personal partner!

...Amarillo Slim

AMARILLO SLIM'S REAL POKER FIVE CARD STUD **plays and teaches.** Match your skills against 3 tough computer opponents. Ask the **tutor** for advice. You control stakes, limits and table positions.

As you play, your skills are analyzed to help you improve your game.

Easy to use sophisticated features make it fun to play real POKER, the most popular card game ever played!

CIRCLE 238 ON READER SERVICE CARD

A Perfect Defense Doesn't Have To Cost Billions

From the man who wrote the book on data recovery comes the premier software defense against data loss. Mace Gold offers 17 programs to help safeguard your data and keep your hard disk running reliably and efficiently.

On guard with Mace Gold you have, foremost, *Mace Backup*, a fast, convenient, fail-safe way to save and restore hard disk data. *Remedy* stands in reserve, ready to find and automatically fix the inevitable weak spots on your disk before they can threaten valuable files. *POP*, our power-out protection software, can carry you past brown-outs, blackouts and keyboard lock-ups. And *Vaccine* stands as a final line of defense against "bombs," "viruses," and the odd "trojan horse."

No defense is perfect if it can't recover, and Mace Gold provides what you would expect, the best data recovery there is. *UnDelete* and *UnFormat* offer flawless recovery of deleted files and entire disks. *TextFix* and *dBFix* go beyond simple ASCII retrieval to automatically find and rebuild lost, corrupted or damaged word processing and dBase files without losing precious format information. And now

there's *MUSE*, a sector editor intelligent enough to teach you, and packed with enough recovery power to resurrect the "deadest" of disks.

Of course, the best defense is still a strong offense, and Mace Gold gives you just what you need to keep your system moving fast and efficiently. With fast disk caching in regular, extended or EMS memory, quick and reliable file consolidation with *UnFrag*, and directory sorting and squeezing, Mace Gold can minimize wear and tear on your disk—and your fighting spirit.

For all this, Mace Gold offers an exceptional balance of features, performance, ease of use, and price when evaluated against the competition under everyday working conditions.

Add the benefit of having a company that specializes in recovering the unrecoverable working for you, and you'll never find yourself having to think the unthinkable about the safety of your precious files.

After Hours

Streets on Disk
CONTINUED

or ZIP code.

You can also load a file of places of interest on each map and search for them too. This list of places can easily be edited. By including your own places of interest, you can develop what amount to personalized maps.

You can even add streets or addresses that are absent—although the maps are based on data from the 1990 Census (yes, sounds odd, but that is 1990—the Census Bureau can't find people next year unless it has all the addresses now, and it has published that data).

The program computes the best route between two or more locations, but be prepared for a wait. Even on a 25-MHz 386 machine equipped with a math coprocessor, a 7-mile route through central Los Angeles took about 15 minutes.

Streets on a Disk uses local maps to plot the most efficient driving route to the destination you specify.

Slower systems take longer, depending on the processor used and whether a math coprocessor is installed. Heavy use calls for a well-endowed system including a large hard disk.

You can print out maps and route directions on an HP Laser-Jet or Epson-compatible dot matrix printer.

Lest you think the program comes with detailed street information for the entire United States, keep in mind that the data for the state of California alone costs about $12,000 and runs to several hundred megabytes.

Streets on a Disk does come with one basic map of the major U.S. roads; you'll need to purchase extra map sets for specific localities. For Los Angeles, San

Francisco, and Chicago, maps of the major local streets are available for $20 each. Otherwise, you'll need one of the individual packages that are available for all the counties in the U.S. Maps are also available for parts of several counties.

Prices are typically in the $100 to $150 range, but a small county like Manhattan is $70, while St. Lucie County, Florida, weighs in at a whopping $2,210. These maps take considerable disk space: the two we looked at were Manhattan, at 800K, and the Wilshire Corridor subset of Los Angeles, at 2.2MB and $150.

If you want to know where you are going and how to get there, *Streets on a Disk* may appeal to you.

List Price: *Streets on a Disk,* Version 3.0, $150; add-on maps at various prices. **Requires:** DOS 2.0 or later, 512K RAM, graphics adapter; hard disk strongly recommended. Klynas Engineering, P.O. Box 499, Simi Valley, CA 93062; (805) 583-1029.

CIRCLE 542 ON READER SERVICE CARD

Abort, Retry, Fail?

The Lighter Side of Personal Computing

You Should Have Seen the Error Rate With Constant Linear Velocity

"The [Ricoh rewritable optical] drive uses highly reliable constant angular velocity tracking, yielding an error rate of about one in every 10-12 bits read."
—*Design Fax*, July 1989.

And when they grow beyond 3.5 inches, some of the lower-quality drives show an error rate of one in every 10-12 bits read. (Headline from *PC Week,* July 24, 1989.)

Meanwhile, the Dusseldorf Office Has a 10-Year Overstock of Kanji Turbo Prolog

"While Compaq's international business may be ahead of other PC companies, most companies see opportunities overseas. A number of software companies, including Borland, have recently added Japan to their list of European offices."
—*InfoWorld,* May 29, 1989

"SURE WE CAN FIX IT, BUT IN THE FUTURE REMEMBER THAT BRUTE FORCE ISN'T THE BEST APPROACH."

Duties include upgrading office from beta release.
(Want ad in the *Hollywood Reporter,* July 21, 1989.)

Why We Remain Suspicious Of the Mac Market

"512K Macintosh computer—external disk drive, and ImageWriter printer, $900 (bicycle included).
Call xxx-xxxx."
—Want ad, the *Village Advocate,* Carrboro, N.C., June 6, 1989